THE GLASS INDUSTRY
VOLUME 17, NUMBER 6, JUNE, 1936

OAKLAND FACTORY TO BE WORLD'S FINEST

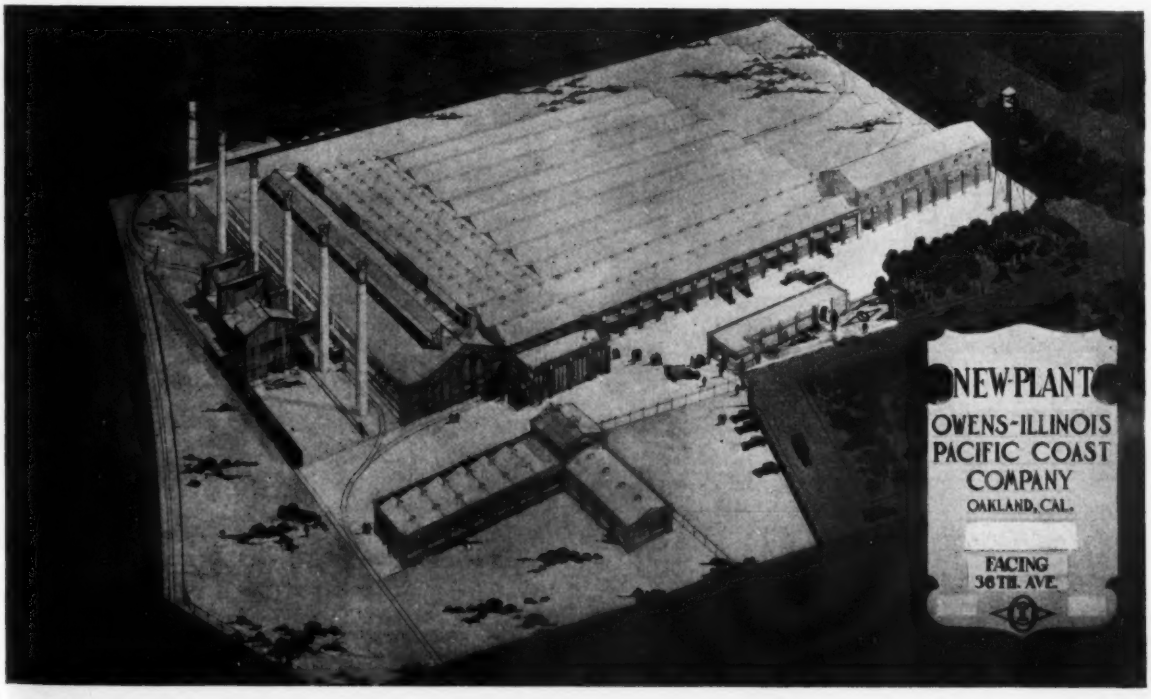
FIRST DETAILS OF THE OWENS-ILLINOIS PACIFIC COAST COMPANY'S NEW PLANT WHICH WILL BE PLACED IN OPERATION JANUARY FIRST

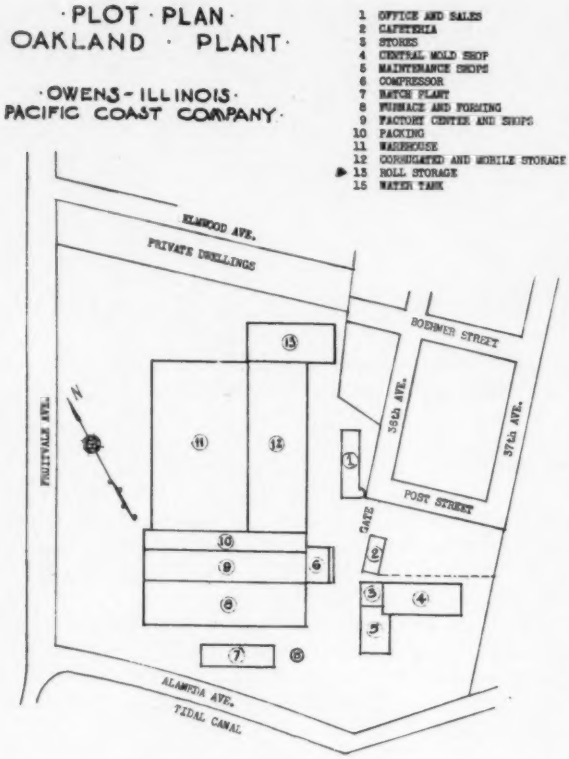
WHEN President J. P. Levis of the Owens-Illinois Pacific Coast Co. announced last January that his firm would build a new factory in the San Francisco area, glass men throughout the United States realized that this would probably mean a new manufacturing unit which would embody the highest achievements in the field.

Nor will these high expectations be disappointed, judging from the data and construction details made available to The GLASS INDUSTRY through the courtesy of Owens-Illinois Pacific Coast Co. officials. Not only will the new factory be equipped with the most modern machinery for the production of all sizes, kinds and colors of glass containers, but the buildings themselves will incorporate many refinements in construction hitherto unknown in glass factories.

Responsibility for the actual construction of the plant will rest in the capable hands of P. D. Burtt, veteran industrialist and vice-president of the Owens-Illinois Pacific Coast Co. Tucked away on the fourth floor of the old Wells-Fargo Building in the heart of San Francisco, Mr. Burtt is directing the operations which, it is expected, will be completed by January 1937. Just what he is undertaking may be judged from the architect's drawing, the plot plan of the property and the explanatory data that follows.

The site of the factory is a 22 acre tract on Fruitvale Ave., at the Estuary in Oakland. Present construction plans call for the actual utilization of only nine acres, leaving ample room for future expansion. Buildings will be of concrete and steel (non-combustible mill type). Exteriors will be of brick and of new Insulux glass building blocks, manufactured by the parent company, to admit the maximum of diffused light. Many of the interior partitions will also be of Insulux block, and the whole made soundproof and insulated with glass wool. Particular attention is being given to lighting and ventilating, and here again another Owens-Illinois product will be used extensively—air filters made of glass wool, to maintain a supply of clear pure air.





With this idea of the general plan of construction, we can now turn to the architect's drawing and follow the layout of the various buildings and departments.

The L-shaped building in the center foreground will house the Stores, Central Mold Shop, and Maintenance Shop. By this arrangement, the Stores will be directly accessible to the Mold and Maintenance Shops. The Salvage Department is to be located in the Stores, thus giving the Stores control of it.

Just to the rear of this building is a projection of the main plant, which will be the Compressor Building. This will be air-conditioned. Owens-Illinois glass air filters will be used in the air-conditioning units, housing all air compressors, vacuum producing equipment, electrical controls, battery chargers, and oil pumps. Thus the Forming Department, located just to the rear of this building, will be in the best position for the distribution of compressed air, vacuum lines, and electricity. Adjacent to the Compressor Building, but not shown in the picture, will be the primary outdoor electric substation. Small boilers supplying steam for the Corrugated Department will be located here. This is to be the only use of steam throughout the entire plant, the remainder of the equipment utilizing electricity.

The building projecting at the extreme left of the main factory is to be the Batch Plant. It will be constructed of concrete and steel and will contain two rows of cylindrical bins, five in each row, with a total capacity of approximately 5,000 tons. All colors of glass batch will be mixed without contamination. Raw materials will be handled with power shovels, bucket elevators, and spouts to the various storage bins. The batching and weighing system will be located directly under the bins and will be fully automatic, operated by only one man, similar to the one recently installed at the Owens-Illinois Columbus plant.

The automatically weighed batch materials will be discharged into skip hoist buckets, and then elevated and discharged into the mixers, which are located above and at one end of the storage bins. From the mixers the batch will be conveyed by buckets, each holding one mixed batch on a mono-rail system to the furnace feeding line. The loaded batch buckets will be hauled in trains of six each by an automatically controlled tractor on the overhead mono-rail, and after being discharged, will be returned to the batch plant in the same way.

The cullet from both the Forming and Packing Departments will be handled in buckets on a mono-rail system in the basement under these departments and will be conveyed through a tunnel at basement level to the batch plant, where it will be crushed, elevated, and discharged into the storage bins. Furnace-tapped cullet will be discharged directly into open cars behind the furnaces and thence to the same crushing equipment in the batch plant. All of the equipment used will be dust-tight, and in addition, a dust collecting system will be installed. A plant laboratory will be located in the batch plant for preliminary control of raw materials.

Directly to the right of the batch plant and extending the entire width of the building will be the Furnace and Forming Departments, in which five furnaces will be installed. They will be serviced by brick lined concrete stacks 140 feet high, and will be equipped for natural gas or fuel oil firing. The furnace construction is such that the furnace can be increased or decreased in size with a minimum of expense and they are designed for both feeder and Owens machine operation. A 10-ton overhead crane travelling the full length of the Forming Department will handle equipment from the basement along the forming machine line and will greatly facilitate making machine changes. The roof of this building will have a ventilator extending the full length of the main building.

The lehrs, extending the entire width of the building, will occupy that portion of the main building directly to the right of the Furnace and Forming Departments and will extend as far as the right end of the Compressor building. Situated on the mezzanine floor over the lehrs will be the Central Washroom, Mold Repair, Factory Center, Machine Repair, and Machine Storage. The Mold Storage will be located directly under the lehrs in the basement. On the mezzanine floor throughout the entire width of the main building on the Forming Department side will be a runway. All of the shops and also the Factory Center will open out on this runway, making it easy to deliver molds and other small pieces of equipment to the Forming Department. The Factory Center will house the offices of the operating departments of the Factory and Packing Divisions, a large meeting room, and the History and Specifications Department.

Just to the right of the lehrs will be the Packing Department, likewise extending the entire width of the main building, but occupying only approximately half as much space as the lehrs. The corrugated cases will be delivered to the lehrs by an overhead conveyor system from a balcony over the rear portion of the Packing Department.

Dividing the remainder of the building roughly in

half, the rear section located in the background will be devoted to the warehouse, which will have one story on the same floor level as the Packing Department. Hand piling, machine piling, or the pallet system can be used. The warehouse will be serviced by two 9-car spur tracks throughout its length. The warehouse floor and the car floor will be on the same level.

The portion of the main building corresponding to the warehouse, but located in the foreground, will have two floors. The first floor will house the mobile Storage and Shipping Departments, and the Corrugated Department will occupy the second floor of this building. The mobile storage area will be used for outgoing shipments which are to be held for a few days. This procedure will save handling such goods twice, as they will not have to be put in the warehouse. The first floor will be at car and truck floor level. The Corrugated Department will be serviced by an elevator and chutes to the Shipping Department, and is to be on the same level as the balcony of the Packing Department.

The projection of the main building at the extreme right foreground will be the Roll Storage Building. It is adjacent to the Corrugated Department and will be serviced by a spur track. An overhead crane will handle the rolls of corrugated paper from the cars to the storage and from the storage to the Corrugated Department.

The U-shaped building directly in front of the truck entrance will house the Plant Office, Sales Office, Personnel Department, First Aid Room, and Recreation Director's office. The employees will enter the plant through a section of this building under the supervision of a watchman who will also have control over the main entrance gates for trucks. Not shown in this picture is the cafeteria which will occupy the space between the office and the mold shop. It will be arranged so that portions of it may be closed off for small group meetings, club meetings, or moving pictures.

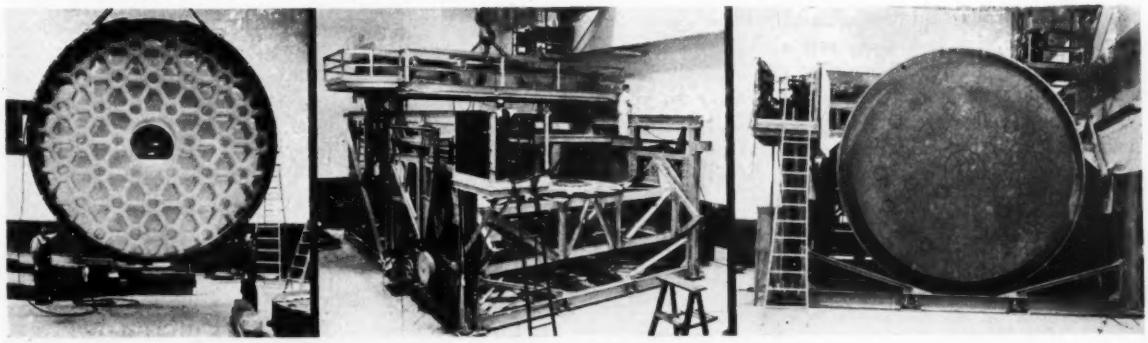
In a sense, the story of this plant begins in 1881, when E. Abramson and A. Heunisch went into business on the Pacific Coast as importers of glass bottles and bottlers' supplies. Their business grew and prospered, and additional lines were taken on when the Illinois Glass Co. acquired an interest in the concern back in the gay nineties. In 1898, the Abramson & Heunisch Glass Co., as the firm was then called, took over the San Francisco and Pacific Glass Works and began building the present plant at 15th & Folsom Streets, San Francisco. The Illinois Glass Co. had a jobbing business on the Pacific Coast, and in 1903 consolidated with the Abramson & Heunisch Glass Co. to become the Illinois Pacific Glass Co. Until 1924, the firm was a closed corporation, but in that year, a reorganization took place and stock was offered to the public in the name of the Illinois Pacific Glass Corporation. The next few years were occupied in keeping up with the rapid development on the Pacific Coast and the ever increasing new uses for glass containers (see The GLASS INDUSTRY, November, 1935). In 1930, the Pacific Coast Glass Works and the Southern Glass Co. were acquired and the firm became the Illinois Pacific Coast Co.

The history of the other branch of this company began in 1873, at Alton, Ill., when Edward Levis and William Elliot Smith started the Illinois Glass Co. A number of years later, Owens and Libbey started their famous Owens Bottle Co., and these firms prospered until they became the two leading glass manufacturers in the United States. In 1929 they merged to become the Owens-Illinois Glass Co., under the leadership of the present president, William E. Levis.

In 1932, Owens-Illinois acquired the Illinois-Pacific Coast Co. and the corporation name was changed to Owens-Illinois Pacific Coast Co. Shortly thereafter, negotiations were completed for the purchase of the present Oakland location.

TO DISSEMINATE BUILDING INFORMATION

The Pittsburgh Glass Institute has been formed to act as an authoritative source of information to which architects and other members of the building industry may turn for information on the increasingly versatile uses of glass as a construction and decorative material. E. L. Patton will be director of the Institute, which will have an advisory board composed of eight members, each an expert in one particular phase of the industry. The primary purpose of the Institute is to assemble and coordinate all available data on the many uses and applications of glass developed by modern manufacture. The address is 30 Rockefeller Plaza, New York.



THE 200-INCH LENS ARRIVES AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY.

Left, the glass reflector blank is shown swinging from the crane. Center shows the grinding machine on which the blank will be placed for grinding. At the right is shown the bed plate of the grinding machine moved to perpendicular position for mounting of the glass blank and also for testing the character of the ground surface during the grinding operation which will take some years for completion. Photographs by Ferdinand Ellerman, courtesy of Dr. John A. Anderson, executive officer of the Observatory Council of the California Institute of Technology.

MELLON RESEARCH ACTIVITIES

The 23rd Annual Report of the Mellon Institute of Industrial Research treats several subjects of interest to glass men. In the field of high temperature insulation, the fellowship has found the emissivities of refractories of a number of different colors and has concluded that, contrary to general belief, the emissivity of light-colored refractories decreases rapidly with increase in temperature, the decrease starting at a temperature of about 400°F. These results will be of interest to metallurgists and of particular concern to electric furnace operators, to whom the cost of energy is a highly important factor.

In the field of illuminating glass, work has been carried forward on two new types of opal glass for light-diffusing purposes. One of these glasses has reached the semi-commercial stage, while the other is still under investigation in the laboratory. A technic for preparing laboratory glass melts in platinum has been worked out, by which small melts can be made without danger of contamination from the crucible and at a cost much lower than that possible with fireclay or sillimanite crucibles. The application of spectroscopy to glass analysis has been studied and a technic developed for obtaining qualitative and even semi-quantitative results. For example, it has been found that fluorine may be determined in glass spectroscopically in a semi-quantitative manner by proper preparation of the sample and examination of the calcium fluoride bands. The fellowship has also cooperated in ascertaining the physical characteristics of glass used for building tile, which is now in active production. One of the latest installations of this tile is in the New York tunnel, where its high mechanical strength and light-reflecting properties have demonstrated the applicability of glass in a new field.

Activities in connection with abrasives have been devoted primarily to the development of a series of refractories to which have been given the generic name "Monofrax." They are produced by melting selected raw materials in the electric furnace, followed by casting in much the same manner as in the case of a metal. Obviously, because of the wide range of conditions that refractories must withstand in service, there can be no universal refractory. Fusion in an electric furnace, however, permits the choice of a wide range of materials, principally refractory oxides, thus providing the definite composition best adapted to each type of application. The production of a refractory by this procedure gives a dense, impenetrable, crystalline structure possessing a high degree of stability, without the use of the bond that is characteristic of the ordinary refractory. The usual refractory generally fails because of surface attack by combined chemical and physical processes and because of penetration of the pores and consequent destruction of the less inert bond, thus dislodging pieces of refractory even before they are dissolved. A cast refractory of the "Monofrax" type not only eliminates the latter cause of failure but also presents a minimal area for attack because it has an impervious surface.

Probably one of the most important projects was a demonstration of the value of X-rays as a research tool in studying abrasive and refractory materials.

The development of new types of resins by the organic synthesis fellowship has been carried on and a new product of the "Vinylite" type, known as "Vinylite X," has been evolved for use in safety glass. A new type of plasticizer has been developed for this resin; and the composition containing the resin and plasticizer, as used in safety glass, is called "Vinal." This plastic may be worked and sheeted by the same process that is used for cellulose acetate and nitrate.

The sheets, produced by any of the standard methods, are placed between plates of glass, and the resulting sandwich is subjected to heat and pressure to obtain adhesion of the plastic and glass. The resulting product is quite superior in every respect to any other type of safety glass. As to break resistance, it will stand approximately ten times as great a blow at —10°F and five times as great at 70°F as any other variety of safety glass. The plastic is resistant to ultraviolet light and withstands 1000 hours' exposure to the "Uviarc" and two years' exposure in Florida without discoloration. The safety glass made with this plastic has been subjected to a temperature of 260°F for 200-300 hours without showing any change, whereas the present type of safety glass is discolored within 40-60 minutes. The new plastic adheres readily to glass; consequently, an adhesive is not required and the safety glass does not require edge-sealing, as the penetration of moisture does not affect the adhesive qualities that cause "let-goes" or shrinkage along the edges. The plastic is quite elastic and yet is very strong. In this glass it tends to absorb blows, thereby conducing to the elimination of the conchoidal pieces of glass that are ordinarily knocked from the inside plate opposite the point of impact.

REVIEW

Sands, Clays and Minerals, Vol. II, No. 4, April 1936. Published by A. L. Curtis, Chatteris, England.

Appearing in this issue of *Sands, Clays and Minerals* are several articles of interest to glass technologists.

An article by W. M. Hampton on "The Efficiency of Heat Absorbing Glasses" contains interesting information on methods of specifying numerically the efficiency of such glasses under actual conditions of use and also the efficiency of one heat absorbing glass as compared with others of the same type. An extract from Hampton's discussion on the use of such glasses will apear in the July issue of The GLASS INDUSTRY.

H. Laithwaite in his article on "Minerals for Coloring Glass and Enamels" discusses the various glass colorants and briefly describes their characteristics, sources and methods of use.

An article on "The Use of the Spectrograph in Industry" by H. W. Lohse is of special interest to the glass chemist as it deals with the rapid estimation of the various elements by means of the spectrograph. The equipment and method of use is fully described and typical analyses of ceramic and other materials are given.

Articles of secondary interest to the field of glass technology appearing in this issue include: "The Zirconia Deposits of Brazil," "Analytical Notes on White Earths and Pigments," "A New Sand Classifier," etc.

National Safety Council, Inc., points out that the name of its Quarry Section has been changed to the Mineral Aggregates Section in order to more completely describe the membership of this group.

THE EFFECT OF COMPOSITION UPON THE SCRATCH HARDNESS OF CERTAIN GLASSES

By C. W. PARMELEE and K. C. LYON

THE property of physical hardness has never been so clearly defined that its value is independent of the method of measurement. Usually the method is chosen with regard to the investigator's concept of the proper method of study. The resistance of glass to abrasion, to impact, to penetration, to scratching, and to compressive surface failure has found use in evaluating hardness.

The present investigation has been limited to a study of the resistance of glass to scratching by a diamond point. This type of test was chosen because scratching can deface, weaken, and even make a glass article unusable. A sclerometer and a uniform procedure were used to compare glasses with minerals from the Mohs scale. The effect of chemical composition upon the scratch hardness is reported here.

It is not expected that these results will agree with those obtained from other methods which are basically different. There would certainly not be an agreement with those methods which depend on the failure of the surface in compressive loading. There is a possibility of agreement with the results of abrasion tests. The past fifty years have seen a number of worthwhile investigations of the hardness of glasses.

The principal studies of the hardness of glass which have been made may be summarized as follows:

Auerbach[1] used an indentation method for studying the hardness of a large group of glasses. A ball was pressed against a plate of the same material until failure of the surface of the plate occurred. From tests on minerals the common glasses were found to lie between 4½ and seven on the Mohs scale. Clear silica glass was found to have a hardness of five. Factors which were calculated on the basis of the results assigned negative values to lime and soda; all other common oxides used in glass making were found as positive. Auerbach's factors do not show agreement with the one found in this investigation because of the different methods used of testing and different methods of expressing hardness.

Schneider[2] proposed a hardness test which depended on the rebound of a steel ball from a glass surface.

Lecrenier[3] studied the effect of composition upon the resistance to abrasion of a glass plate pressed against a grinding wheel. The resistance to abrasion was found to increase when silica was replaced by lime.

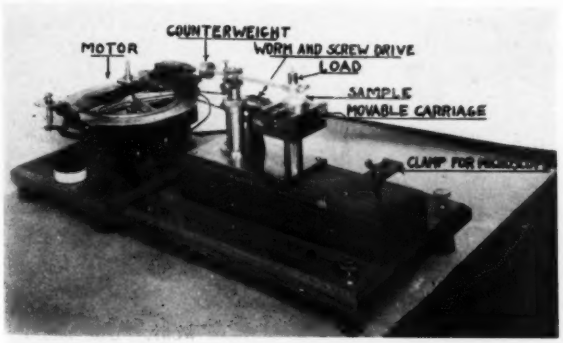


Fig. 1. The apparatus used.

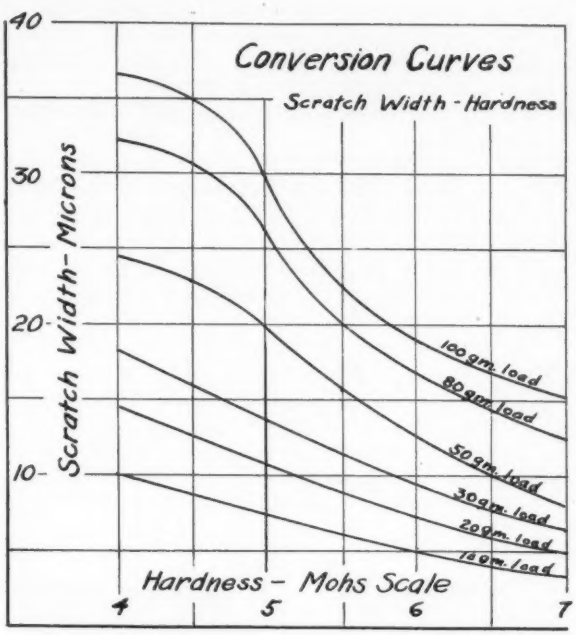


Fig. 2. Conversion of scratch width to hardness.

Berndt[4] found no difference in the scratch hardness between a strained and an unstrained sample of borosilicate glass.

Gehlhoff and Thomas[5] investigated the scratch hardness of a group of glasses which had been first treated with acid. They reported that all the test glasses had nearly the same hardness when tested on fire-polished surfaces. The advisability of the use of the preliminary acid etching might be questioned because of its effect on the practical meaning of the values. The results of the tests were given in arbitrary units and were summarized by groups of curves which represented the effects of the substitution of other oxides for the silica of the base glass.

Lai and Silverman[6], and Becker[7] studied the scratch hardness of beryllium-containing glasses. Lai and Silverman found that glasses of the Na_2O-BeO-SiO_2 group had a hardness lying between 6.2 and 6.7 of the Mohs scale.

Navias[8] made hand scratching tests on some glasses. He found bottle glass to lie below five on the Mohs scale and chemical glass to be between five and six in hardness.

Holland and Turner[9] scratched ordinary plate and toughened glasses and found little difference in widths of the scratches. They reported that the scratches were much narrower near edges than at the center of the toughened glass sheets.

Pirani and Fehse[10] tested the mechanical working properties of glasses by measuring the dulling of a tool held against a test piece in a lathe. They also

found the depth of hole drilled in glass in a given time under standard conditions. The latter method was considered the more reliable as a measure of hardness.

Schmidt and von Gronow[11] adapted a pendulum tester for measuring the hardness of glass. They have investigated the effect of additions of a number of oxides upon the hardness of glass. The authors claim agreement between the results of their method and the results obtained by Gehlhoff and Thomas.

Scholes[12] has recently made some tests of the abrasion of glasses.

Peters and Knoop[13] have begun an investigation of the hardness of glasses by determining the amount of penetration of a sharpened diamond under a given load. Bailey[14] has attempted to arrive at the scratch resisting properties of glass by finding the load under which a glass surface fails when pressed with a rolling steel ball.

THE apparatus (Fig. 1) which was used in this determination was a modification of the classic Martens sclerometer. It embodied the principal features of an instrument used by Talmage[15], differing from it in that the loading was accomplished by placing suitable weights on a platform directly over the scratching point. The diamond scratching point was formed by three planes at 130° to each other. The apparatus was driven by a phonograph motor which imparted a uniform slow motion to the specimen as it was moved under the scratching point.

The scratches were measured with a microscope having a magnification of about 1000 X. The sample was lighted with a vertical illuminator.

The diamond was mounted with its point downward. It was turned so that one of the edges formed by its planes would meet the glass sample squarely as it was moved to form the scratch. The counter-weight was adjusted to put the beam carrying the scratching point in balance, and the height of the beam was set so that it was level when the point touched the glass surface.

The samples were prepared by melting analyzed glass powders in platinum crucibles in an electric furnace. The melts were poured to form glass buttons of one-inch diameter. These were annealed and were set in Wood's metal for mounting in the scratching apparatus. Before making any scratches, the test piece was cleaned with acetone.

A scratching test consisted of making six parallel scratches with loads of 10, 20, 30, 50, 80, and 100 grams, respectively, on the scratching point. The length of the scratches was about 0.5 cm., and the rate of scratching was 0.27 cm. per minute. Three tests were usually made on each sample of glass.

The scratches were measured after the scratching point had been swung to one side. Seven measurements were made along each scratch unless the chipping conditions were so bad as not to permit a clear view of the path of the scratching point. The photographs of Fig. 3 represent a typical group of scratches.

Table 1 lists the minerals which were used for calibration purposes. A single sample of each mineral was used.

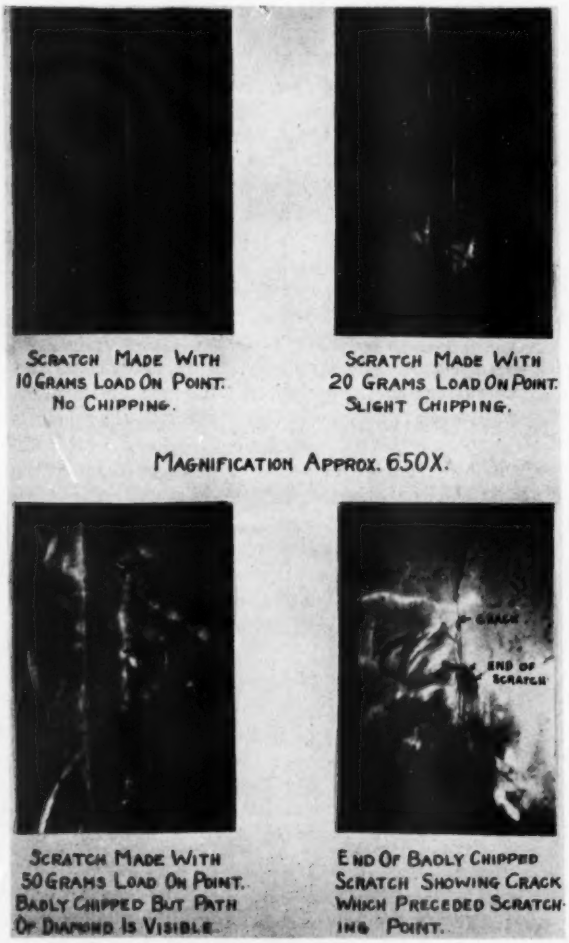

SCRATCH MADE WITH 10 GRAMS LOAD ON POINT. NO CHIPPING.
SCRATCH MADE WITH 20 GRAMS LOAD ON POINT. SLIGHT CHIPPING.
MAGNIFICATION APPROX. 650X.
SCRATCH MADE WITH 50 GRAMS LOAD ON POINT. BADLY CHIPPED BUT PATH OF DIAMOND IS VISIBLE.
END OF BADLY CHIPPED SCRATCH SHOWING CRACK WHICH PRECEDED SCRATCHING POINT.
CRACK
END OF SCRATCH

Fig. 3. Photomicrographs of diamond scratches on glass.

Table 1—Calibrating Minerals

Mineral	Mohs Scale No.	Geographic Source	Crystal Face Scratched	Direction of Scratching
Fluorite	4	Southern Illinois	111	Perpendicular to trace of cleavage
Apatite	5	Austria	1100	Parallel to a-axis
Orthoclase	6	Madagascar	001	Parallel to a-axis
Quartz	7	Arkansas	1100	Parallel to a-axis

The standard procedure was followed in getting data from these minerals. Because of the severe chipping of all of these except fluorite, it was necessary to make measurements at points of minimum width. Such a method was adopted by Hodge and McKay[16]. The measurements made on the minerals served as a basis for drawing the curves of Fig. 2 which afforded a means of converting the scratch widths to Mohs scale hardness.

The scratches made on the glass samples were measured at several points. The average width of the scratches made with any one loading was calculated, and the calibration curves were used in determining the hardness as shown by that loading. The hardness values for each of the six different loadings were then averaged to get the mean value for the sample.

The diamond point was examined microscopically from time to time throughout the period of the scratching tests. It showed no observable wear. One sample of glass was reserved for use in checking the repro-

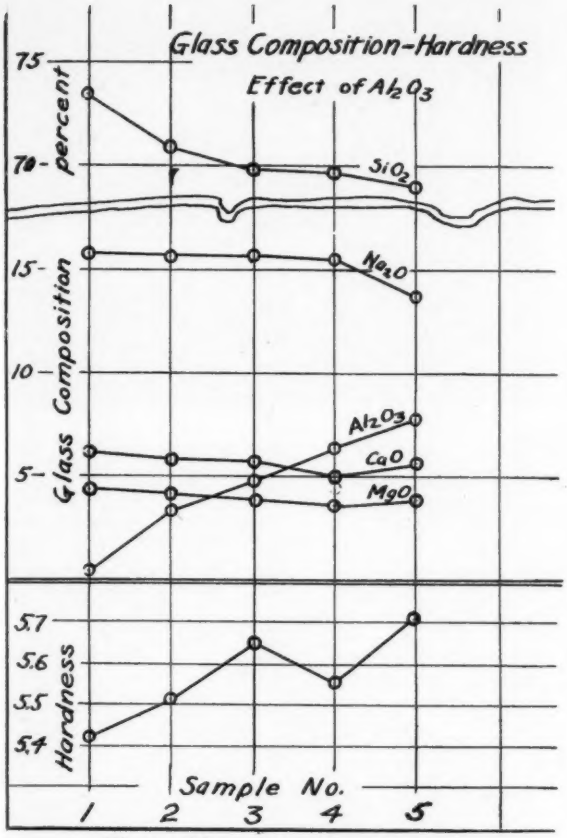


Fig. 4. Effect of alumina on hardness.

ducibility of scratches made with the point. After some 600 scratches had been made the hardness of the glass was found as 5.54. The value was found as 5.53 after some 1500 scratches had been made.

The chemical analyses and the hardness values of the glasses considered in this paper are given in Table 2. The analyses were furnished by Bailey and Sharp Co.

Table 2—Composition and Hardness of Test Glasses

Sample No.	SiO_2	Al_2O_3	CaO	MgO	Na_2O	Hardness
1	73.50%	0.35%	6.07%	4.38%	15.68%	5.42
2	70.92	3.36	5.88	4.14	15.70	5.51
3	69.90	4.75	5.75	3.92	15.68	5.65
4	69.73	6.33	4.95	3.60	15.39	5.56
5	69.00	7.71	5.61	3.90	13.78	5.71
6	72.7	1.2	10.7	...	15.4	5.48
7	72.5	0.7	11.2	...	15.6	5.51
8	72.7	0.7	12.9	...	13.7	5.81
9	72.6	1.5	10.5	...	15.4	5.40
10	71.8	2.3	10.6	...	15.3	5.38
11	72.5	2.3	11.5	...	13.7	5.58
12	100.	...	...	...	...	6.31

The hardness tests were carried out on the natural surfaces resulting from cooling the molten glass in air.

The glasses represented by the numbers 1 to 5 were made in the laboratories of the Department of Ceramic Engineering of the University of Illinois. The batches were made up by adding alumina in increasing amounts to a base glass. If these five glasses are considered in a group, the effect of alumina on the hardness can be seen by reference to Fig. 4. The break in the curve corresponding to glass No. 4 is due to the disproportionate reduction in the lime and magnesia contents.

The factors which express the approximate effect of the addition of one per cent of the oxide upon the hardness of the glasses are given in Table 3.

Table 3—Hardness Factors

SO_2	0.0630
Al_2O_3	0.100
CaO	0.129
MgO	0.170
Na_2O	—0.038

These factors were found by a process of "cut and try." They are more satisfactory than the ones resulting from the solution of simultaneous equations. They are subject to the limitations applicable to this type of factor. Their inherent weaknesses must be borne in mind when calculations are made using them.

Summary—The scratch hardness of the glasses investigated lie between 5.38 and 5.81 (silica glass 6.31) of the Mohs scale. Magnesia and lime are most effective in increasing the scratch hardness of glass, and soda decreases the hardness.

The authors wish to acknowledge the assistance rendered by Mr. F. C. Flint in supplying certain of the glass samples and in having the analysis of others made. The Illinois State Geological Survey kindly permitted the use of certain optical equipment. This paper is based upon data obtained by the junior author in preparation of a thesis which has been accepted by the Graduate School of the University of Illinois in partial fulfillment of the requirements for the degree of Ph.D.

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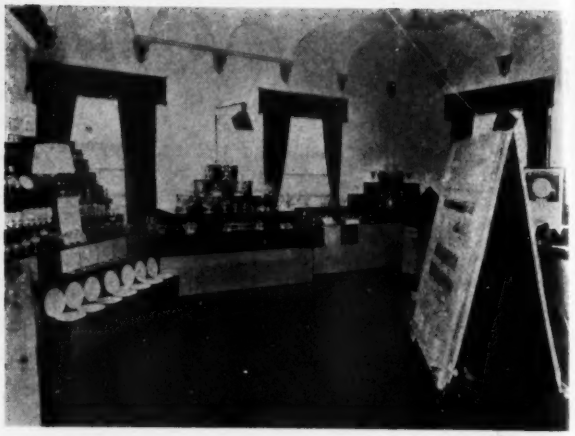
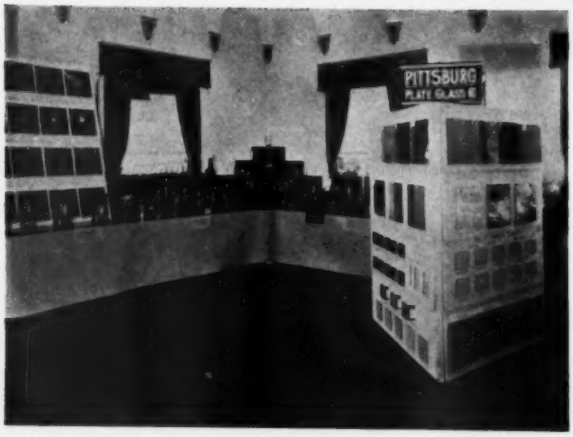
STREAMLINE SERVICE STATIONS FOR OHIO

Fifteen ultra-modern service stations of streamline design, with rounded corners and completely enclosed by horizontal bands of plate glass, are to be built by the Standard Oil Co. of Ohio this spring. Except for narrow red, white and blue porcelain enamel bands encircling the base and roof levels, they will have glass from top to bottom, with a porcelain enamel sash to emphasize the horizontal sweep and curves of the panes. Fabrication of materials for the initial group of stations has already been started by the Austin Co., Cleveland.

THE RUTGERS CERAMIC EXPOSITION

Illustrated on this page are several of the exhibits at the pre-eminently successful fourth Ceramic Exposition of the Department of Ceramics at Rutgers University, New Brunswick, N. J. Exhibits of products were supplemented by demonstrations of processes. Among these was the miniature glass plant loaned by Bausch & Lomb Optical Co. and shown below. The registered attendance was approximately 7,500, among which were some 600 students, 350 high school chemists as well as several hundred chemists and engineers. From the standpoint of attendance, quality of the exhibits, and interest shown, the Exposition was declared the best held to date.





Those in the photograph above are: first row, V. V. Kelsey, President of Ceramic Association of New Jersey; Ross C. Purdy, Secretary, American Ceramic Society; F. C. Flint, President, American Ceramic Society; L. E. Barringer, Prof. G. H. Brown, Director of the Department of Ceramics, Rutgers University, and Secretary-Treasurer of the Ceramics Association of New Jersey; H. P. Humphrey, Washington, N. J.

Second row, John T. Ogden, Editor of "Glass Industry"; Col. Warren S. Hood, Prof. J. F. Kauffman, Dept. of Ceramics, Rutgers University; E. V. Eskesen, H. F. Kleinfeldt, Charles Brian, P. D. Helser.

Top row standing, G. C. Betz, S. J. McDowell, Leslie Brown, F. W. Dinsmore, R. P. Hazelhurst, W. A. Seger R. L. Clare, Alfred Mathiasen, F. R. Valentine, M.D., Prof G. T. Faust, Dept. of Ceramics, Rutgers University and Fred Sutterlin.

SECOND INTERNATIONAL CONGRESS ON GLASS

READERS of The Glass Industry will be the first to receive a detailed report of the Second International Congress on Glass, which will be held in England from July 2 to 11. Arrangements have been made with Professor Samuel R. Scholes of Alfred University, secretary of the glass division of the American Ceramic Society, to represent The Glass Industry at this world conference on glass problems and to report the proceedings exclusively for this journal. Professor Scholes will sail from New York on June 19 and will return before the August number goes to press. He will bring back with him the first transcript of his report for that issue.

Last minute word from Professor W. E. S. Turner, General Organizing Secretary, is that plans for the International Congress have been entirely completed. Glass men from all over the world will attend, as the Congress is attracting the most wide-spread interest. American participation will be extensive. In addition to sending at least four delegates, this country will have five speakers on the technical program: F. C. Flint, J. C. Hostetter, G. W. Morey, S. R. Scholes and W. C. Taylor.

The Congress will hold its meetings in both London and Sheffield. Those in London (up to July 5) will be held in the rooms of the Institution of Electrical Engineers, at the Savoy Plaza, supplemented by a nearby lecture theatre loaned by the Electric Light Manufacturers Association. In Sheffield, meetings will be held in the University Buildings.

The Technical Program

The Technical Program will be constituted of formal lectures delivered before the General Sessions of the Congress and of Technical Group Discussions. The former will be limited in number so that not more than two whole days will be taken up with their delivery. The Technical Group Discussions will give a wide opportunity for glass technologists to enter into an exchange of opinion on a selected number of subjects.

The interests of those attending the Congress are so many and so varied that it has been found impossible to limit the number of subjects to the comparatively small number originally proposed. This has made it necessary to divide the program into four groups, and to have at least three of them meet simultaneously.

Group I contains subjects which it should be profitable to discuss by the members interested in the publication of literature and in drawing up specifications and standards. As the result of the interchange of information and experience about these subjects it may be possible to devise methods of improving existing practice and means also for international co-operation. The program for Group I follows:

(1) Glass Technological Literature
- (a) Nomenclature and definitions.
- (b) Abbreviations in the literature.
- (c) Stimuli to International Exchange. Directories and Bibliographies.

(2) Specifications and Standards for Glassware and Methods of Testing.

Group II will be concerned with problems connected with the manufacture and properties of glass. Methods of chemical analysis are supremely important but are probably less well understood by glass technologists than the more general problems of manufacture and properties. For this reason a separate sub-group has been formed to confer on a limited number of such analytical operations as need improvement and common agreement. This program will consist of:

Manufacture and Properties of Glass.
Sub-Group 1.

The Analysis of Raw Materials and Glasses.
In particular, the determination of traces of iron in raw materials and in glass.

Sub-Group 2.

(1) The Problem of Decoloring Glass.
Including methods of determining color tint.

(2) The Chemical Corrosion of Glass.

(a) A Standard Method of Test for Glass as Glass.
Comparison of American, English and German methods, based on use of glass powder.

Control of glass grinding and sieving to ensure uniformity of grain size.

(b) Methods Applicable to certain Glass Articles (bottles, chemical glassware, ampoules, etc.).

(3) Mechanical Strength of Glass.
(a) Methods of measurement and the factors which influence results.
(b) Interpretation of measurements.

(4) The Thermal Endurance of Glass.
(a) A general method for determining the thermal endurance of glass as glass.
(b) Methods applicable to certain forms of glassware.

(5) Annealing Temperature.
Its definition and relation to softening temperature, and in particular to viscosity.

Group III. Refractory Materials, Fuels and Furnaces.
(1) The Testing of Tank Blocks.
(2) Refractory Packings: Properties, Shapes and Sizes.
(3) Nomenclature and Formulae relating to Glass Furnace Performance.
(4) The Cooling and the Insulation of Furnaces.
(5) The Flow of Glass in Tank Furnaces.

Group IV will be concerned with the manipulation, form, design and decoration of glass. It attempts what perhaps is not altogether easy yet is highly important, namely, to correlate technical knowledge and artistic ideas in the manufacture of glass by mechanical processes. The list of subjects that follows is provisional.

Group IV. The Manipulation, Form, Design and Decorating of Glass.
(1) Special Metals and Alloys in Glass Manufacturing Processes.
(2) The Design of Machine-Produced Domestic Glassware.
(3) The Use of Sand Blasting as a Decorative Treatment for Glass.
(4) The Prelude to European Cut Glass.
(5) Examples Illustrating the Present-day Development of Glass Decoration in Germany.
(6) Visits to the British Museum and the Victoria and Albert Museum.

Elaborate arrangements have been made to entertain overseas visitors to the Congress. Luncheons, dinners, banquets and dances have been scheduled at such celebrated places as the Trocadero and Park Lane. An excursion has been arranged for July 4 which will embrace many sights and points of interest in the neighborhood of London. En route to Sheffield, members of the Congress will pay a visit to Oxford University.

Plant visits will include two large steel mills, and the following glass factories: (*Concluded on page* 212)

CONTROL OF FURNACE PRESSURE AND COMBUSTION IN THE GLASS MELTING TANK

By L. D. CARLYON
Bailey Meter Company

AS in other lines of industry, the glass manufacturer is forever faced with the problem of reducing production costs in order to maintain or widen the margin of profit. Since the art of glass melting involves the use of equipment representing a sizeable investment and also the consumption of gas or oil in large quantities, it follows that two of the items of cost which show the greatest possibilities for reduction are those of refractory maintenance and fuel.

In glass melting practice it is well understood that only the heat developed above the temperature of the batch is available for absorption by the glass. Furthermore, the rate of heat transfer increases tremendously with an increase in flame temperature. Therefore, for economical operation it is desirable to maintain a high flame temperature, yet avoid damage to the furnace refractories.

These conditions can be secured and maintained only by controlling furnace pressure and combustion with the aid of proper operating guides in the form of meters and recorders, or by means of automatic control equipment. With either method, meters provide knowledge of any changes in furnace conditions and permit comparison of results obtained with different operating schedules. From this definite information regarding the process, optimum conditions can be determined and adopted as standard practice. Furthermore, proper control results in equalized firing from each side of the tank, the ability to main-

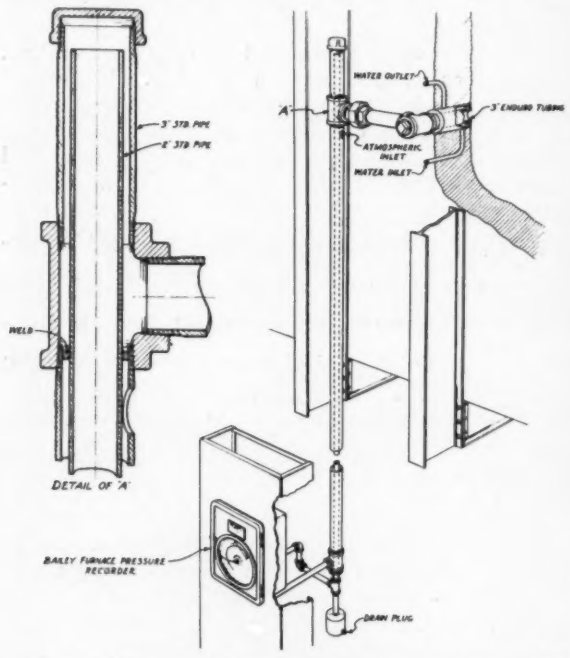
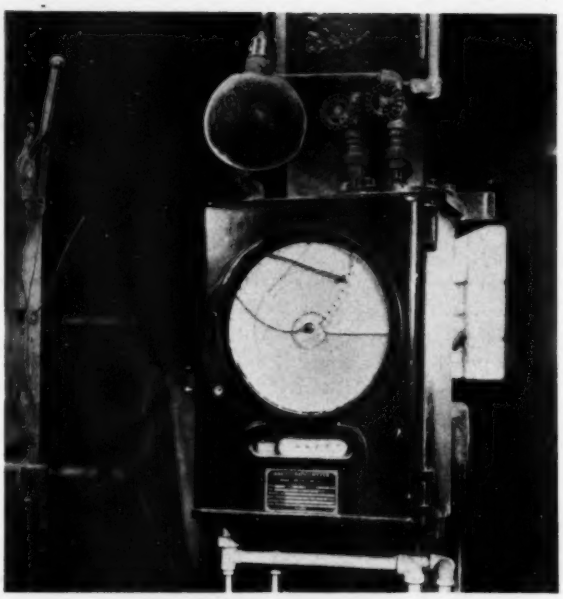


Fig. 1. Dual type of furnace connection as recommended for use with the furnace pressure recorder. If preferred, the connection can be taken through the crown of the glass melting tank rather than through the wall as shown in this picture. It is also satisfactory to run two individual pipes side by side in place of one pipe within the other.



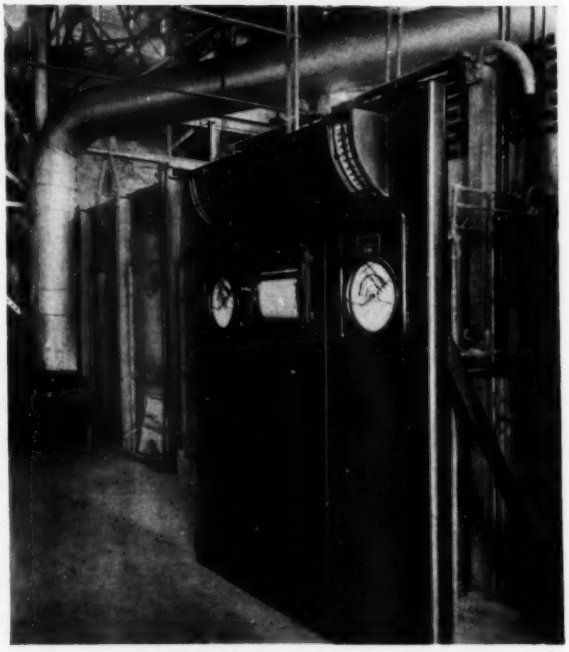


Fig. 2. Fuel Flow—Air Flow Meter installed on a glass melting tank. The use of this meter has resulted in an improved quality of glass and in a reduction of over 150,000 cu. ft. of gas per day for the same volume of glass output.

Fig. 3. This panel board centralizes instruments installed to guide operation of two glass furnaces at Capstan Glass Co., Connellsville, Pa. On each furnace a Fuel Flow—Air Flow Meter indicates, records and integrates gas flow through a 4" line and records the Air Flow for combustion through a 20" forced draft duct. Gas pressure is also recorded. A Multi-Pointer Gage indicates furnace draft and uptake draft of each furnace.

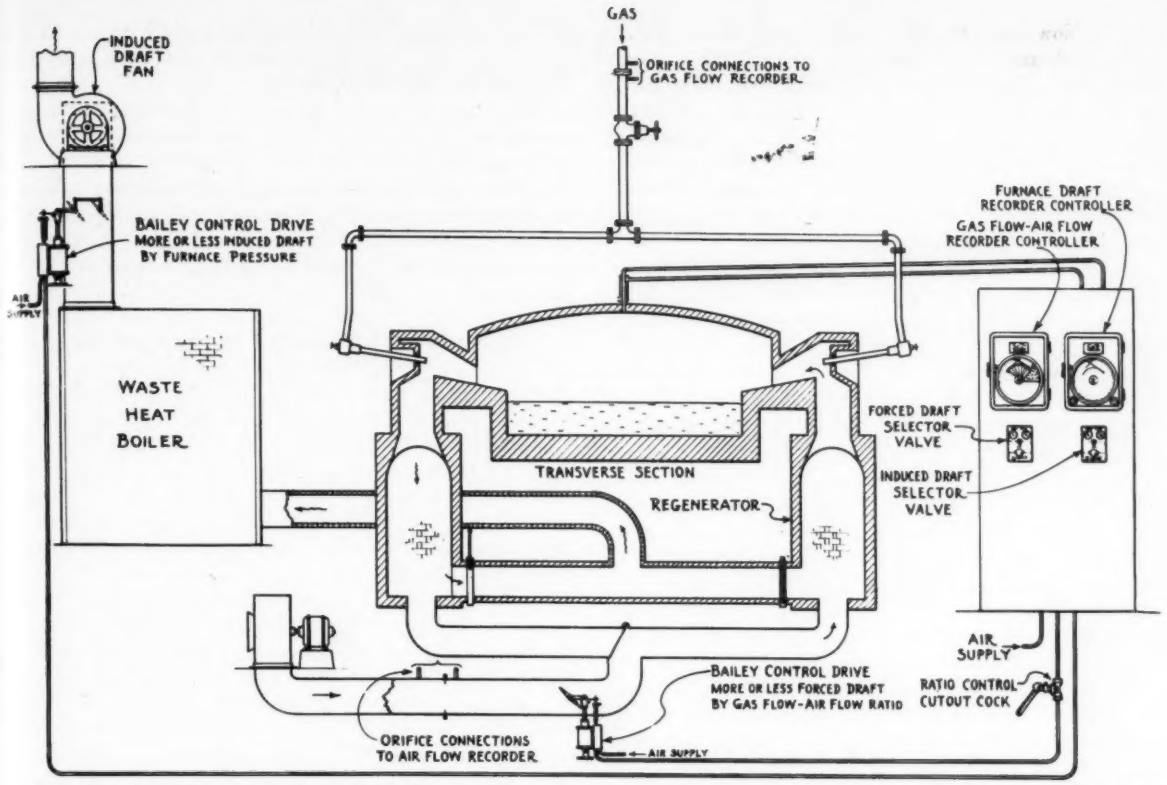

GAS
INDUCED DRAFT FAN
ORIFICE CONNECTIONS TO GAS FLOW RECORDER
FURNACE DRAFT RECORDER CONTROLLER
GAS FLOW-AIR FLOW RECORDER CONTROLLER
BAILEY CONTROL DRIVE MORE OR LESS INDUCED DRAFT BY FURNACE PRESSURE
AIR SUPPLY
WASTE HEAT BOILER
FORCED DRAFT SELECTOR VALVE
INDUCED DRAFT SELECTOR VALVE
TRANSVERSE SECTION
REGENERATOR
AIR SUPPLY
BAILEY CONTROL DRIVE MORE OR LESS FORCED DRAFT BY GAS FLOW-AIR FLOW RATIO
RATIO CONTROL CUTOUT COCK
ORIFICE CONNECTIONS TO AIR FLOW RECORDER
AIR SUPPLY

Fig. 4. Diagrammatic drawing illustrating the application of air-operated control equipment to a glass melting tank.

tain a uniform rate of operation, and usually an improvement in the quality of the glass.

Though the application of the equipment necessary to obtain control of either furnace pressure or combustion alone can usually be justified from the improvements secured, a combination of both types of control proves more than doubly worthwhile since each improves the functioning of the other. This is true whether the control is carried out manually or on a fully automatic basis.

Controlling Furnace Pressure

The furnace pressure maintained in a glass tank has an important influence on both the combustion conditions and the life of the furnace. A high furnace pressure causes flame impingement and also flame penetration into the brickwork, both of which are disastrous to furnace life. A high furnace draft causes cold air infiltration through the brickwork, ports, and other openings. Leakage of this type represents a serious loss in that it not only decreases the available heat by reducing flame temperature but also enters the furnace at points where it is not likely to take part in the combustion process.

By use of a Furnace Pressure Recorder, shown in Fig. 1, operators are provided with information which enables them to regulate the uptake damper so as to maintain correct furnace pressure.

Because of the necessity of measuring and controlling furnace pressure with precision, the method of making draft connections between the furnace and the recorder is of paramount importance. Experience has shown that the dual connection illustrated in Fig. 1 is satisfactory. This arrangement requires a differential type of mechanism in the recorder such as two oil-sealed bells suspended from opposite ends of a pivoted beam. One bell is connected to furnace pressure by means of the inner pipe; the other is connected to atmospheric pressure at the same level as the furnace tap by means of the outer pipe.

A recorder with but one connecting line and one operating bell, is likely to be subject to error due to the high temperatures adjacent to the furnace causing a decrease in the density of the gas in the line. This results in a chimney action in the vertical rise of the connecting piping and therefore a false pressure would be transmitted to the bell. With a recorder having two bells, however, the effects of chimney action are applied to each of the two oil-sealed bells, thus counter-balancing the error so that only actual changes in furnace pressure cause movement of the recording pen. Therefore the chart record is a true representation of furnace pressure.

Obtaining Efficient Combustion

Most economical combustion conditions can be secured only when the air and fuel are fired in the correct proportion. Too much air results in a heat loss to the stack, whereas too little air will cause the deposition of carbon which may easily color the glass and also results in a loss due to unburned fuel.

A Fuel Flow—Air Flow ratio meter of the type shown in Fig. 2 provides operators with a reliable guide for combustion, enabling them to maintain a definite relation between the amounts of air and fuel supplied to the furnace. The meter contains two recording pens; one records the rate of gas flow or oil flow, and the other records the rate of air flow supplied for combustion.

Upon installation the meter is adjusted in accordance with actual combustion tests so that records of fuel flow

and air flow coincide when the correct ratio exists between fuel and air. Thereafter the furnace operator merely has to keep the two pens together by manipulating the air supply in order to secure economical fuel consumption, and at the same time avoid a reducing atmosphere. If the Air Flow pen is above the Fuel Flow pen, it indicates that too much air is being supplied; and conversely, if the Air Flow pen is below the Fuel Flow pen, too little air is being supplied.

In addition to serving as a combustion guide, a meter of this type is valuable as a fluid meter on the fuel line. It records and indicates the rate of flow in the desired terms and registers the total flow on an integrator counter.

The recording pens of the Fuel Flow—Air Flow meter are actuated by simple mechanisms which receive their motive power from the differential pressure produced by thin plate orifices installed in the fuel and air lines.

Installation of the orifices is normally a simple matter when the tanks are fired with oil or natural gas and have a forced air supply. When producer gas is used as the fuel, the steam supply to the injector or fan turbine is measured and used as an index of fuel flow since direct measurement of the gas is not advisable because of the large amount of tar and other foreign matter which it contains.

With natural draft glass tanks, the air supply cannot be measured satisfactorily but installation of forced draft equipment may be justified on the basis of savings effected through utilization of the metering equipment.

Value Of Automatic Control

Although manual control of furnace pressure and combustion produces improved tank performance and economy, for maximum results the control should be accomplished automatically.

Automatic control provides advantages in addition to those listed for manual control which cannot be secured by any other means. It frees the operators from the vigilance required by manual methods of regulation and permits them to devote a larger portion of their time to other important duties. Furthermore, it makes the proper correction for a faulty condition, immediately when the change is sensed by the meter or recorder, whereas with manual control the condition must actually change sufficiently to be apparent in the record or indication of the instrument before the operator can take the necessary steps to make an adjustment. Automatic control, therefore, provides the most uniform, economical operation.

A typical installation of automatic control of the air-operated type as applied to a glass melting tank is illustrated in Fig. 4. The metering equipment consists of a Fuel Flow—Air Flow ratio meter and a Furnace Pressure recorder as previously described, each of which contains an air pilot valve for commanding the movements of the associated control drives.

One control drive positions the uptake damper to maintain furnace pressure and the other drive positions the damper in the forced draft duct to regulate the air supply in accordance with the fuel-air ratio.

Selector valves on the panel board provide a means of manual control of either drive when desired. A cutout cock is also provided adjacent to the reversing control post to permit rendering the ratio control equipment inoperative during a reversal of the furnace. This eliminates unnecessary furnace disturbances during reversals and insures purging the checkers of waste gases before firing in the opposite direction.

Every furnace project must be considered individually insofar as operation is concerned, and adjustments in the equipment made accordingly. Naturally there is no advantage to be gained from stable operation if incorrect standards are maintained. However, continued unvarying observance of values, which by experience and knowledge are found to be best, should be of tangible value in reducing production costs.

LIBBEY-OWENS-FORD PROGRAM OF BUILDING EXPANSION

Detailed plans for a $700,000 building expansion program at the Rossford and East Toledo plants of the Libbey-Owens-Ford Glass Co., are expected to be ready for contractor estimates about June 15. Actual construction work is expected to start soon after. A large addition will be made at Rossford, a suburb of Toledo, and a new steel and brick boiler house will be erected at the East Toledo plant, providing the company with more than 122,000 square feet of additional floor space.

A new packing and shipping room, 80 by 400 feet, will be constructed at Rossford for plate glass. There will be three large truck doorways and a railway siding, with an overhead electric crane in the building. Another room, 150 by 233 feet, will be added for inspection, cutting and storage of large-size plate glass. Six overhead electric cranes will be installed, along with glass storage racks, examining stands, cutting tables and washing machines. A ware room, 60 by 260 feet, will be built for storage and cutting of the Vitrolite type of structural glass, with cutting tables, racks and an overhead crane. An addition to the box and carpenter shop, 95 by 110 feet, will be constructed to house all carpenter work of the entire plant. Two other new extensions, each 75 by 90 feet, will be used to handle and store materials, and additional locker room facilities, with an area of 8,700 square feet, will have steel lockers, numerous showers and a modern first-aid hospital unit. There will also be a new storage room, 42 by 104 feet, for packing materials.

The Rossford addition will have shale brick exteriors, with ample steel sash, all to match the present architecture. Roofs will be of built-up composition on concrete tile, supported by steel beams and trusses, with floors of hard-finished concrete. The project will entail the construction of about 50,000 square feet of reinforced concrete roadways, various sewers, water lines and an almost complete rearrangement of railroad trackage.

The new boiler house for the East Toledo plant will house a new steam generating unit to supplement present steam facilities at that plant.

TO PROTECT SPANISH BOTTLE INDUSTRY

Miles Hammond, assistant U. S. trade commissioner in Madrid, reports that a protective committee to regulate and encourage the bottle making industry has been created by order of the Spanish Council of Ministers. This committee will regulate production and trade in glass products in its jurisdiction, as well as stimulate consumption and export. The primary purpose of this regulation will be to co-ordinate the various interests, to propose improvements and promote foreign sales.

GLASS CONTAINER MEETING SHOWS INCREASED PROSPERITY OF INDUSTRY

THE annual meeting of the Glass Container Association was held on May 6, 7 and 8 at the Greenbriar Hotel, White Sulphur Springs, West Virginia. Essentially an occasion for promoting good will and mutual understanding by social contacts, this convention was every whit as successful as its many memorable predecessors.

Group meetings of the Cap and Closure and of the Glass Divisions were held on Wednesday and Friday, with an open session sandwiched in between on Thursday. The golf tournament was run off on Thursday afternoon, followed by a banquet and dance. The only innovation of note was the omission of the floor show. In its place Mr. Heuisler imported one of Baltimore's leading orchestras for dancing.

The Association reelected all of its officers and directors, making the official family consist of: W. H. McClure, Hazel-Atlas Glass Co., president; H. C. Mandeville, Thatcher Manufacturing Co., first vice president; George S. Bacon, Whitall Tatum Co., second vice president; and V. L. Hall, Glass Container Association, secretary-treasurer. Directors: F. J. Petty, Ball Brothers Co.; F. L. Lloyd, Crown Cork & Seal Co.; H. L. Lonsdale, Phoenix Metal Cap Co.; H. C. Mandeville, Thatcher Manufacturing Co.; J. H. Rau, Jr., Fairmount Glass Works; P. I. Heuisler, Maryland Glass Corp.; C. D. King, General Glass Corp.; J. W. King, Dominion Glass Co.; G. F. Lang, Carr-Lowrey Glass Co.; H. G. Phillips, Owens-Illinois Glass Co.; A. F. Reed, F. E. Reed Glass Co.; I. R. Stewart, Anchor Cap & Closure Corp.; R. R. Underwood, Knox Glass Associates. Officers of the Association are also directors.

The open session was called to order by president McClure, who forsook precedent by eliminating the numerous committee reports. In their place, the activities of the past fiscal year were reported by E. G. Ackerman, assistant business manager; Victor Hall, secretary-treasurer, and W. H. Norrington, in charge of publicity and statistics.

Mr. Ackerman first dealt with legislation. Perhaps the most important pending legislation, he stated, is the revival of the old Copyright Registration of Designs Bill, now known as the Duffy Bill S3047. This would permit any individual to copyright any artistic model or design simply by depositing five photostat copies and a two dollar fee with the Registrar of Copyrights. As The GLASS INDUSTRY pointed out editorially in May, this legislation would not serve the purpose intended and could only result in chaos.

The Association also opposes the Wheeler Anti-Basing Bill (S4055) on the ground that it would tend to force the re-allocation of glass producing units and concentrate them around thickly populated areas. This would cause a tremendous loss of invested capital to the industry. Other bills upon which Mr. Ackerman commented were the new Patman Bill (H.R. 8442) to prohibit price discrimination between customers on and F.O.B. factory basis rather than on a delivered basis; the Borah-Van Nuys Bill to extend the authority of the Federal Trade Commission over price discrimination; the Wheeler Bill by which the Federal Trade Commission could prohibit unfair or deceptive acts or practices; the Ellenbogen Bill creating a little NRA for the textile industry; and the Healy-Walsh Bill requiring certain labor standards on all government contracts.

TARIFF MATTERS

PASSING from legislation to tariff matters, Mr. Ackerman stated that no important increases in the importation of common bottles or perfume bottles had been reported in 1935. However, the Association had taken an active interest in several important cases before the Customs Court. The first of these concerned the importation of automatic machine made bottles, importers claiming that any machine operation in the production of a bottle constituted automatic machine operation under the tariff act. The Association devoted much time to preparing a brief against this contention; but the importers avoided bringing the case to trial by withdrawing their protests.

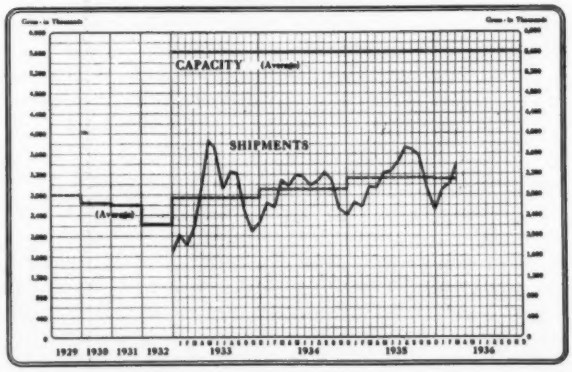
Japanese importations are constituting a serious threat to the entire American glass container industry. Investigation has revealed that Japan is able to lay down bottles, duty paid, in our important markets at a price about 60 per cent of what it costs to manufacture them in this country. In many cases, the Japanese are able to put a great deal of hand labor into these bottles, which still further accentuates the price discrepancy. The Association has filed a brief and the matter is being kept open. Meanwhile anyone who meets with this competition should report it to the Association, supplying the name of the purchaser, the price, samples of the bottle, etc.

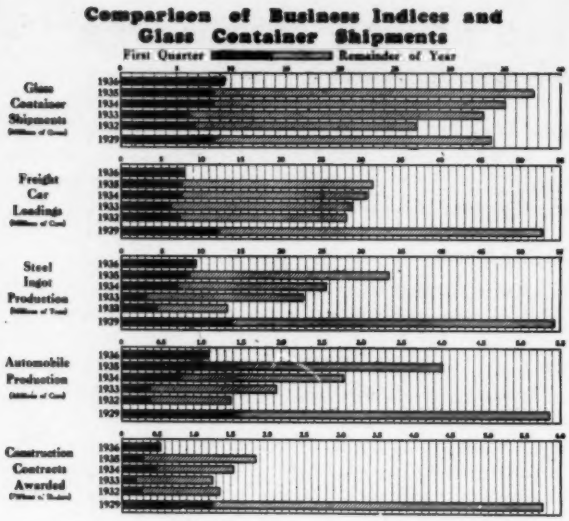
In the matter of liquor bottle markings, Mr. Ackerman reported that the Federal Alcohol Administration and the Treasury Department were feeling the utmost satisfaction. These bottle markings have succeeded to a great extent in stamping out bootlegging and this in turn has markedly increased tax receipts.

BEER AND MILK BOTTLE PUBLICITY

THE Association has devoted much time during the past year to fact-finding and publicity on the merits of the beer bottle and milk bottle over the competitive

Total Industry Shipments Compared with Productive Capacity by Months





containers—the tin can for beer and the paper bottle for milk. Publicity in connection with these matters has been largely under the direction of W. H. Norrington. The beer can has attracted more general attention because the campaign has been national in scope. The paper milk container, on the other hand, has affected only certain local areas. In his report, Mr. Norrington warned the industry that if the public accepts the tin can for beer, there are many other products that might be accepted just as readily. There are rumors of a winery in California planning to package wines in tins. Tin cans are being offered for peanut butter, and it is reported that requests have been made to the Alcohol Tax Unit for the privilege of packing liquor in tin.

The Committee appointed to develop the beer bottle program has had a very difficult task because the problem is so widespread, and because the can companies are willing to pour such an enormous expenditure into the capturing of this market. So far as can be determined, the three can companies spent for their own account in 1935 approximately $500,000. The can companies no doubt also contributed generously to the $800,000 worth of advertising of the three leading brewers who are packaging their beer in cans. This total of $1,300,000 covers only money spent for magazines, newspaper and radio advertising, and does not include all the dealer helps, booklets, posters, etc.

The Committee believes that its work in behalf of beer bottles has been effective and that it has been able in many cases to stem the advance of the tin beer container. Testimonials from brewers and actual fact-finding surveys would seem to bear out this belief. The coming summer months, however, will prove the severest test of the campaign against cans for beer.

The milk bottle situation differs from the beer problem in that it is intertwined with state and municipality control regulations. Such regulations as a mandatory bottle deposit in northern New Jersey and New York City prevent the dairies meeting the situation in their own way. Through surveys in the different markets, labatory tests and cost studies, the Committee has thoroughly analyzed the various phases of its problem. These facts have been disseminated to the dairies and public officials through the medium of *The Bottle Front* and by personal visits. Armed with these facts, the dairies are taking the problem to the control authorities and demanding action.

The situation at present is that milk is being sold wholesale to stores in paper containers by only five milk dealers. They are operating in Trenton and Philadelphia, New York City, Newark, N. J., Allentown and Cleveland. There have been no additional paper installations similar to the above since last summer, and, in fact, one dairy using paper during 1935 discontinued its use on Dec. 31, 1935. However, in the northern New Jersey and metropolitan New York markets, a number of the smaller dairies have started using pre-formed paper containers for store distribution. All of these dairies have expressed a definite preference for glass, but have claimed that the competition of chain stores selling milk in paper has created a demand for paper on the part of the independent store merchants which they are serving.

As a result of the experience gained during the past year, the following definite conclusions have been formed:

1. That consumers buying milk from stores do not prefer the paper container when glass and paper sell for the same price and no deposit is charged on the glass bottle.

2. That the cost of the paper container is at least one cent greater than the cost per trip of glass and that this difference in cost cannot be overcome through economies in the other operations.

The Traffic Situation

THE traffic problems of the industry are handled by J. C. Magness. Because they are governed by commodity rather than class rates, tariffs are more or less continuously in an agitated rate due to the temporary nature of such commodity rates.

Last May a new adjustment of sand rates effective July 1 was reported. While these rates represented substantial reductions in the aggregate, they failed to grant all that the industry believed it was entitled to. Efforts will be continued to convince the Interstate Commerce Commission that rates should be no higher for transporting sand to the glass industry than to other receivers.

Last May a new adjustment of the carload bottle rates in Official territory was reported. These were published to expire on a stated date, which has been extended to Dec. 31, 1936. Efforts are being made to have this adjustment made permanent. The present emergency charges are scheduled to expire June 30 and the Association believes that if they should be continued beyond that date it will be for only a short period of time.

The question of shipping bottles in cartons, that do not comply with Rule 41 as a form of bulk loading, is receiving considerable attention. This type of shipment has been permitted in practice for years but on Feb. 15 the railroads undertook to cancel the arrangement, which was extended until Sept. 15, pending further developments.

In 1935 the railroads made an adjustment on the rates for shipping burned lime in Eastern territory and provided a lower level of rates on fluxing lime for the steel mills. Recently the Interstate Commerce Commission made a decision which agrees with the Association's contention that these fluxing lime rates should be available

for the glass industry, and the practical advantage of this decision is being developed.

There is considerable chaos in the matter of truck shipments due to the fact that the class tariffs which apply here differ so widely from each other. It was expected that on April 1 the truck rates and rules would be uniform and with some relationship to the rail rates so as to furnish a comprehensive picture. It is undoubtedly the intention of the Interstate Commerce Commission to bring about order, uniformity and some sort of relationship in respect to the transportation facilities of the country as a whole. But until this is done, the GCA stands ready to furnish the best information available.

Charles R. Stevenson, business manager of the Association, outlined conditions in the United States in general and hopes and fears for the future of the glass industry. Mr. Stevenson pointed out that the industry is operating on an ascending scale and while the outlook is promising, it calls for constant vigilance in a year marked by political claims and counter-claims.

Victor Hall's Statistical Report

ONE of the most interesting features of the meeting was Mr. Hall's statistical report in which he outlined the relationship of the glass industry to economic conditions in general. These findings are admirably expressed in the attached charts and tables.

The first chart shows the steady increase in the volume of shipments since the low year of 1932, when the volume of shipments was 39.7 per cent of productive capacity. By 1935 shipments represented 55.7 per cent of productive capacity. In the first quarter of 1936 shipments increased 14.03 per cent as compared with the same period of 1935. Indeed, with the exception of fruit jars and jelly glasses, all lines showed an increase over the same period in 1935.

A comparison with four basic industries shows that the glass industry is in a class by itself in that volume for 1934 and 1935 exceeded the former peak period of 1929. As far as freight car loadings of consumers' goods was concerned, they were still 40 per cent behind 1929. While steel ingot production in 1935 was 38.5 per cent below the 1929 figure, it was 10 per cent ahead of last year during the first quarter of 1936. Automobile production, although it has shown the greatest recovery of any of the basic industries, was still 25 per cent below its record volume in 1929. The construction industry has not registered any substantial gain, although the first quarter of this year showed a good gain over the same period in 1935.

One of the most important questions of the day is that of unemployment, and Mr. Hall has done a most interesting job in analyzing the various reports on the subject. The United States Census of April 1930 showed 48,162,802 gainful workers between the ages of 16 and 64 years. It also disclosed that of this total 6.62 per cent or 3,187,647 were unemployed for various normal reasons, including those who do not have to work and those who do not want to work.

Using these census figures of April 1930 as a base, the National Industrial Conference Board has made regular surveys on which they have based estimates of the total unemployed workers. The estimates reached the peak in March 1933 with total of 12,450,500. By March of this year they show a reduction to 7,524,294. However, the census figures show an excess of new workers coming of age over those reaching the retirement age of 64. From 1930 to March 1933 such new workers numbered 1,086,000 and by March 1936, 2,125,000. With the addition of this figure the Conference Board's estimate of total unemployed in March was 9,649,294. This figure is probably ultra conservative in that accurate estimates are impossible covering agriculture and certain other classes of workers not definitely attached to particular industry groups.

While the employment data for the glass industry starts with 1929, the study of the United States Census of Manufactures suggested that 17,963 employees shown for April 1930 was the greatest number attached to the industry up to date. The census figures do not subdivide employment between the divisions of the glass industry but do subdivide the value of the product. A study of the following comparison of value of glass containers with total value of glass industry products warrants the view that 1929 represented the peak employment to that date.

In March 1933 there were 15,609 employees. Considering that the glass industry should be responsible

WHO ARE THE JOBLESS?

	Gainful Workers Age 16-64 April-1930 ①	Unemployed Workers April-1930 ①	% to Gainful Workers	Unemployed Workers March-1933 ③	% to Gainful Workers	Unemployed Workers March-1936 ③	% to Gainful Workers
Total Industry	48,162,802	3,187,647	6.62	12,450,500	25.85	7,524,294	15.62
Allowance for New Workers (Since 1930 Census)	---	---	---	1,086,000	2.26	2,125,000	4.41
TOTALS	48,162,802	3,187,647	6.62	13,536,500	28.11	9,649,294	20.03
Glass Container Industry	17,963	---	---	2,760	15.39	+(7,654)	42.69

Class of Industry	Gainful Workers Age 16-64 April-1930 ①	Workers on Relief Age 16-64 March-1935 ②	% to Gainful Workers
Agriculture	10,002,501	993,038	9.93
Forestry & Fishing	248,907	38,964	15.65
Extraction of Minerals	983,139	158,764	16.15
Manufacturing & Mechanical	14,042,386	2,405,434	17.13
Transportation & Communication	3,834,430	118,110	3.08
Trade	6,031,852	374,648	6.21
Public Service	855,730	151,051	17.65
Professional Service	3,249,040	82,440	2.54
Domestic & Personal	4,906,306	617,673	12.59
Clerical Occupations	4,008,521	216,098	5.39
Inexperienced	---	956,309	---
TOTALS	48,162,802	6,112,529	12.69

① U S Census ② W P A Labor Inventory ③ Nat'l Industrial Conference Board

Occupational Characteristics
Gainful Workers and Workers on Relief

Occupational Classification	Gainful Workers Age 16-64 April-1930 ①	% to Total	Workers on Relief Age 16-64 March-1935 ②	% to Total	Assumed Distribution Estimated Unemployed March-1936	% to Gainful Workers
Unskilled	10,066,026	20.9	1,882,659	30.8	2,971,983	29.53
Semi-Skilled	7,368,909	15.3	1,320,306	21.6	2,084,248	28.28
Skilled Workers and Foremen	6,309,327	13.1	898,542	14.7	1,418,446	22.48
Domestic and Personal	4,190,164	8.7	757,954	12.4	1,196,512	28.56
Farmers	5,683,210	11.8	568,465	9.3	897,384	15.79
Office Workers	4,671,792	9.7	262,839	4.3	414,920	8.86
Salesmen and Kindred Workers	3,323,232	6.9	220,051	3.6	347,375	10.45
Professional and Technical	3,034,257	6.3	103,913	1.7	164,037	5.41
Proprietors, Managers and Officials	3,515,885	7.3	97,800	1.6	154,389	4.39
TOTALS	48,162,802	100.0	6,112,529	100.0	9,649,294 ③	20.03

① U S Census ② W P A Labor Inventory ③ Nat'l Industrial Conference Board

for its share of the new workers, there were 2,760 unemployed glass container workers as of March 1933. However, a labor survey last fall showed a total of 26,409 employees which means that in addition to absorbing its share of new workers 7,654 workers have been absorbed from other industries.

	Employees in Glass Industry	Value of Product of Glass Industry	Value of Product Glass Container Ind.
1925	69,371	$295,959,424	$100,301,407
1927	65,825	282,394,330	114,380,546
1929	67,500	303,818,560	121,643,925

A recent study by the National Industrial Conference Board entitled "Machinery Employment and Purchasing Power" presents some interesting data on employment and is well worth reading. The study brings out the major changes in occupations and the many new opportunities for gainful employment due to the increase in output person as a result of the machine. In 1870 with a population of about 42,000,000, 32.4 per cent, or 13,000,000, were listed as gainful workers. Of this total, 76 per cent were engaged in production of goods, in agriculture, manufacturing and mining while only 24 per cent were available for all other economic activities.

In 1930, 39.8 per cent of the population or nearly 49,000,000 were listed as gainful workers. The enormously increased volume of commodities as compared with 1870 was produced by only 53 per cent while 47 per cent of the working population was engaged in transportation, trade and the service industries.

The change in agriculture as an employer of labor is one of the important developments shown by the Conference Board's study. In 1870 agriculture gave employment to 7,000,000 people or more than half of the working population. In 1930 farmers and farm workers represented only about 21 per cent. While the total number of gainful workers has increased steadily the slightly over 10,000,000 workers in agriculture in 1930 is actually less than the number shown in 1920.

A common view of the unemployment problem is that new industries are the only solution. Many people contend that the automobile and other new industries prevented the occurrence of our present problem much earlier. The Conference Board study refutes this line of reasoning and shows that new industries could not take up any appreciable percentage of the unemployed. The study reveals that 18 new manufacturing industries which came into existence since 1879 accounted for only 18 per cent of the total increase in employment. During 1929 these new industries employed 1,123,000 workers or approximately one-eighth of all workers in manufacturing industries.

The 1930 census also classified the total gainful workers according to occupations. As shown by the chart, 20.9 per cent were unskilled, 15.3 per cent semi-skilled, 13.1 per cent skilled workers and foremen, etc.

Also, the WPA labor inventory in March 1935 classified the 6,112,529 workers on relief according to occupations. Comparing this column with the total gainful workers, 30.8 per cent of the relief workers were unskilled as compared with 20.9 per cent of the total gainful workers in this classification. Likewise, semi-skilled and domestic and personal classifications showed a higher percentage of workers on the relief rolls than these classes show to the total gainful workers.

In the last column the National Industrial Conference Board's estimate of total unemployed (9,649,294) has been distributed over the various occupations in accordance with the percentage figures shown by the labor inventory. Here the number of unemployed not shown on the relief rolls are assumed to follow in the same occupational classification as those on relief. The percentage figures show four classes with a greater than the average number unemployed.

WOMEN PREFER MILK IN BOTTLES

A survey recently conducted by the Glass Container Association showed that only 10.66 per cent of the housewives interviewed expressed a preference for paper containers for milk over the glass bottle. In an examination of container costs, the Association showed that, "the cost of packaging milk in glass is seldom over three mills including storage, handling and washing costs, and that paper containers of all types cost well over one cent and in the majority of cases two cents." The glass bottle, which costs under five cents originally, averages from 20 to 40 trips before it is broken or lost and the initial cost is divided up among the number of deliveries.

REFRACTIVITY OF SOME GLASS-FORMING OXIDES

The relations between specific refractivity of glasses and the physical or chemical properties of the constituent oxides, two empirical expressions have been obtained which apparently correlate specific refractivity of the oxides and the ionic radius of the metallic constituent of the oxide. The two expressions are:

$$RW = 2.49 + 1.394r + 2.031r^3$$

$$(RW)^{2/3} = 1.920 + 1.376r^2$$

In the above equations:

R = the specific refractivity, or the refractivity for yellow light, divided by the density of the oxide.

W = the equivalent weight of the oxide based on the combining weight of oxygen as 8.

r = the ionic radius (in angstroms) of the metallic ion of the oxide.

The specific refractivities of the oxides were obtained by extrapolation of available data on specific refractivities (R) of the glasses to that of the pure oxide. The values of specific refractivities of the oxides and Wyckoff's ionic radii (in angstroms) of the metallic constituent of the corresponding oxide are as follows:

Oxide	R	Radii	Oxide	R	Radii
Al_2O_3	0.2082	0.55	MgO	0.2118	0.75
B_2O_3	.2392	.20	Na_2O	.1936	1.00
BaO	.126	1.38	P_2O_5	.197	.21
BeO	.238	.30	PbO	.134	1.18
CaO	.2244	1.06	SiO_2	.2081	.40
K_2O	.2027	1.35	SrO	.147	1.18
Li_2O	.31	.70			

Using either of the equations and the specific refractivities given above, Wyckoff's values of the ionic radii of the metallic ions can be computed with very good agreement.

If lead is considered as a bivalent atom the above equations do not apply, but they do apply if lead is considered as tetravalent.—*Technical News Bulletin of the National Bureau of Standards, April,* 1936.

NEW YORK CERAMISTS MEET

The Third Annual Meeting of the Ceramic Association of New York was held at the Ceramic College, Alfred University, May 15. Papers were presented on subjects of general interest to the ceramic manufacturers, notably on the control of dust hazards, on the use of "Lumnite" cement for building refractory bodies, on the decoration of brick and tile, and on the de-airing of clay.

Of major interest was an address of Dr. J. C. Hostetter of the Corning Glass Works, who spoke on "Glass as a Construction Material." He showed, by means of a sun lamp, how heat may be readily transmitted through common window glass and focussed in such a way as to ignite an ordinary match. He then interposed a piece of window glass containing ferrous iron, which permitted the light to pass through, while absorbing so much heat that the match was not ignited. He also showed a black pane of glass which was opaque to the visible light but, nevertheless, transmitted enough heat to ignite the match. Dr. Hostetter explained the utility of infra-red-absorbing and of ultra-violet-absorbing glasses in building construction, especially where air-conditioning is employed. He exhibited samples of the new building blocks and explained their utility for lighting, and protecting air-conditioned rooms.

Dr. Hostetter exhibited samples of the newly-developed glass wool in fibers, threads, yarn and woven cloth, as well as the felted bats of glass wool used for thermal insulation of buildings. By means of a moving picture film, he explained the application of this material to the insulation of buildings, and showed how in a nodulized form it may be blown into partition spaces in buildings already constructed. The film also demonstrated some of the details of the production of glass wool.

One of the interesting comments made by Frank Austin of the Binghamton Brick Co., president of the Association, was that although these new materials, especially glass blocks, might seem to offer severe competition to building brick, it would probably be found that the glass product, like any other improvement in building construction, would actually increase the demand for common brick.

The Ceramic Experiment Station, recently provided for by the act of the legislature to be established at Alfred on July 1, 1936, was one of the principal subjects of discussion. Representatives of the ten industrial divisions made suggestions as to subjects of research to be carried on by the new experimental staff. It was generally agreed that, at least during the first year, a survey of the raw material resources of the State should constitute the principal activities of the station.

About 50 representatives of ceramic and glass plants were in attendance. The officers, including those already named and Vice President J. C. Hostetter, were reelected. A new division, "Wall and Floor Tile," was created and Mr. G. D. Phillips of Olean Tile Company was named as representative on the board of directors.

A directory of the ceramic industries of the State has been issued by the Association, edited by G. L. Strubler of the Corning Glass Works and by Dean M. E. Holmes of the Ceramic College, Secretary of the Association.

The 1937 Annual Meeting of the American Ceramic Society will be held at the Waldorf-Astoria, New York City, the week of March 21, 1937. The Ceramic Association of New Jersey will be hosts, and local committees will be appointed by that Association, whose president is V. V. Kelsey.

GLASS EMPLOYMENT HITS HIGH

Statistics recently released by the Department of Labor indicate that employment in the glass industry during 1935 was higher than any year since 1926, with the exception of 1929. The final quarter of 1935 showed a higher index of employment than any quarter since 1926.

In compiling these statistics, the Department of Labor took the average for the years 1923, 1924 and 1925 as 100. In 1935, the index stood at 94.5 as compared with 89.8 in 1934. The banner year of 1926 is represented by 103.8 while the 1929 index was 96.7. The low point of the depression reduced the employment index for the glass industry to 56.9 in 1932.

Payrolls in 1935 showed a definite rise and stood at 82.9, which is equal to that of 1930 and the highest since that year. Payrolls increased steadily during 1935, beginning at 69.9 in January and rising to 94.2 by December. According to the same statistics, the payroll index for all industries was 70.3 during the past year.

It is reported that very few industries showed a better average employment and payroll index than did the glass industry in 1935, as compared with last year.

PUBLICATIONS RECEIVED

Construction Abroad. Construction Circular No. 3. Industrial Division of the Bureau of Foreign and Domestic Commerce.

This publication outlines the plans for construction work throughout the world and should be of great value not only to the glass industry but to members of the construction materials business as well. Nearly all of the countries of the world are covered giving information as to whom and where bids should be submitted.

An Investigation of the Durability of Molding Sands. Bulletin No. 281. Engineering Experiment Station, University of Illinois, Urbana, Ill.

This 53-page publication by Carl H. Casburg and Carl E. Schubert tests various molding sands by the following three methods: the mold test method; the oven test method; and the hydration and de-hydration method. The purpose of these tests was to outline a short and accurate method for determining the durability of a given sample of molding sand and to obtain data which would give the amount of bond or sand necessary to bring a given quantity of used sand back to the original strength without the necessity for conducting a special test.

FOURCO ACQUIRES HARDING GLASS

The Harding Glass Co., Ft. Smith, Ark., has been absorbed by the Fourco Glass Co., Clarksburg, W. Va., and will be operated as one unit in the large group of Fourco plants. The company has been managed by Wayne H. Harding who will continue with the Fourco company. No change in the organization of the Ft. Smith unit is contemplated at present. The products of the Harding plant, which is equipped with two furnaces and nine Fourcault machines having an annual capacity of over 750,000 boxes, will be marketed under the brand name of Clearlite.

GLASS PROBLEMS TO BE DISCUSSED AT ILLINOIS

A Conference on Glass Problems will be held June 5 and 6 in the Department of Ceramic Engineering of the University of Illinois. This will be the fourth conference of a series which has been held in cooperation with the Chicago Section of the American Ceramic Society. As in the previous conferences which have been held in Urbana, the subjects of discussion are of interest to those engaged in glass works operation and control.

The titles of the papers which are to be presented by representatives of various industrial concerns or by the departmental staff are the following:

1. Temperature Measurement and Control in the Glass Industry.
2. Factors Affecting the Presence of Seeds in Glass.
3. Some Notes on Pyroplastics.
4. Heat Transfer in Glass Tanks.
5. The Corning Motion Picture of the Annealing of Glass.
6. Testing of Glass Containers.
7. Identification of Stones in Glass.
8. Batch Separation Studies.
9. Some Characteristics of Fine Glass Fibers.

Members of the glass industry are invited to attend this conference and take part in the informal discussions which follow the presentation of papers. Inquiries may be addressed to C. W. Parmelee, Head of the Department of Ceramics Engineering, University of Illinois, Urbana.

Peter Arno's sophisticated characters, made famous by his magazine illustrations, have been drafted for use as decorations on a variety of gift and household novelties to be placed on the market in the Fall. Edmonson Warrin, Inc., New York, will make a matching line of cocktail and highball glasses, ash trays, cigarette boxes, pitcher and beverage sets, decorated by these characters.

BRAZIL WINDOW GLASS IMPORTS UP

A report from A. W. Childs of the Department of Commerce indicates that the United States is getting only a small part of the Brazilian window glass business, which increased in 1935 to $575,000 from $545,000 in 1934. This increase was due in large measure to a well-maintained general construction program. By far the greater part of this demand was supplied by Germany and Belgium.

In as much as practically all of the window glass used in Brazil is imported, various plans for the establishment of factories and branches there are being discussed at present.

There are tabulated below full and comparable import data for 1934 and 1935, by countries of origin:—

Note: 1:000$000 (one conto) equals approximately $55.00 at the present free rate of exchange and $80.00 at the official rate.

During the floods this Spring, Old Man River knocked at the back door of the Libbey-Owens-Ford Vitrolite plant in Parkersburg, W. Va.

APRIL PLATE GLASS PRODUCTION UP

The total production of polished plate glass by member companies of the Plate Glass Manufacturers of America for April was 19,454,774 square feet as compared to 16,057,196 square feet in March, and 16,998,914 square feet produced in April 1935.

OWENS-ILLINOIS DETAILS PLANS

In a statement filed with the Securities Exchange Commission, the Owens-Illinois Glass Co. reported that during the next two or three years it plans improvements involving expenditures of about $12,500,000. This sum will be divided as follows:

$2,500,000, improvement of the Streator, Ill., glass container manufacturing plant.

$2,000,000, increased facilities for production of industrial materials, including glass blocks and glass fiber.

$2,500,000, expenditures by Owens-Illinois Pacific Coast Co. for construction of a new glass container plant at Oakland, Calif. Further details on this subject will be found on page 187.

$1,000,000, expenditures by Libby Glass Co. for expansion of facilities for the manufacture of thin brown tumblers and stemware.

$2,000,000, expenditures by Owens-Illinois Can Co. for expansion of facilities.

$2,500,000, improvement of facilities of other glass container manufacturing plants.

The company also plans, it was said, to purchase the gas properties of the Berney Bond Gas Co. for $379,327.

Owens-Illinois also said that expenditures by subsidiaries, in the expansion program, would be taken from their available funds when possible.

George Drabbe, agent for the Union Commerciale des Glaceries Belges, Brussels, Belgium, announces that his office is now located at 1643-24th Ave., San Francisco.

IMPORTS OF WINDOW GLASS

Country	1934 Kilos	1934 Milreis	1935 Kilos	1935 Milreis
Belgium	5,049,322	5,514:146$000	7,456,441	6,728:395$000
Germany	2,292,995	2,676:561$000	1,661,941	2,102:344$000
Great Britain	619,221	823:729$00	345,447	590:866$000
United States	158	2:124$000	6,428	116:895$000
Others	113,847	107:548$000	55,002	57,484$000
TOTAL	8,075,543	9,124:108$000	9,525,259	9,595:984$000

SANDWICH GLASS

By ALEXANDER SILVERMAN

Head of the Department of Chemistry, University of Pittsburgh

The first article of the Sandwich series which appeared in the February GLASS INDUSTRY *covered crystal glasses; the second in March, opal and alabaster glasses; the third in April, pink and red glasses; the fourth in May, ambers, yellows, and greens. The present article*[1] *covers various types of blue glasses, pink, lavender, and purple, gray and black glasses, and includes the methods for silvering glass which were employed in Sandwich. The letter K indicates Kern batches and F, Fessenden batches. The roman numerals I and II after the Fessenden batches refer to parts one and two of his records.—The Editor.*

COPPER BLUES

IT WILL be recalled that various copper compounds were employed under reducing conditions in the manufacture of ruby glasses. Copper compounds with oxidizing agents produce blue glasses. The true copper blue is frequently modified by additions of other coloring agents, for example, iron or chromium compounds to produce greenish tones, and cobalt compounds to produce the deeper blue tones which are intermediate between true copper and cobalt shades.

In his notes George L. Fessenden states, "Copper gives a beautiful blue tint by itself. The most delicate tint is obtained from nitrate of copper, but sulfate of copper is more convenient to use and is much cheaper." Although Fessenden states that the nitrate produces the most delicate tint, it is not included in his batches.

F 4-I. Blue Dychroid for Pressed Work:

Flint blacks	800 lb.
Flint batch	100 lb.
Oxide of copper, black	1 lb. 12 oz.
Nitrate of soda	5 lb.

"Flint blacks" probably again refers to a flint cullet which contains nickel oxide as a decolorizer, and it is likely that the flint batch is F 62-II, to which reference was made in previous installments. It is possible that the manganese and cobalt oxides were omitted from the crystal batch, though this does not necessarily follow, especially when reference is made to "flint blacks." The term "dychroid" was interpreted under uranium glasses as meaning dychroic. This interpretation would certainly not apply to any of the glasses in the present installment in whose titles the term "dychroid" appears.

Copper blue cased with cobalt blue. Biotite flakes between layers.

F 61-I. Common Blue:

Sand	100 lb.
Ash	40 lb.
Lead	40 lb.
Salt petre	5 lb.
Green chrome	1 lb.
Black oxide copper	2 lb.

A greenish blue color was produced in this glass through chromium trioxide.

F 59-I. Dychroid Blue:

Sand	150 lb.
Nitrate of soda	80 lb.
Ash	20 lb.
Com. carb. baryte	30 lb.
Arsenic	5 lb.
Lead	50 lb.
Black oxide copper	10 lb.

This is another example of the early knowledge concerning the use of barium carbonate. While mention was made of Fessenden's failure to use copper nitrate though he considered it the best copper coloring agent, note the very large quantity of niter which is employed in this batch and which probably accomplished the same purpose. This batch containing red lead, barium carbonate, and a very large amount of niter must have produced a beautiful glass.

F 43-II. Dycleroide Blue:

Sand	270 lb.
Soda ash 52 degrees	90 lb.
Chalk	90 lb.
Nitrate of soda	10 lb.
Sulphate of copper	4 lb. 8 oz.

This batch is an ordinary copper blue and the first here recorded which contains copper sulfate. It must have been a stable glass considering the high chalk or calcium carbonate content in proportion to soda ash.

F 44-II. Another Dycleroide Blue:

Sand	270 lb.
Soda ash 52 degrees	90 lb.
Chalk	90 lb.
Nitrate of soda	10 lb.
Sulphate of copper	1 lb.
Cobalt	150 gr.

The foundation batch is the same as F 43-II. Note that less sulfate of copper is employed and that cobalt oxide has been introduced. The tone should verge towards a cobalt blue.

COPPER BLUES FOR CASING

SOME of the art pieces which were produced at Sandwich show an appreciable variety of colors in cased glasses. Some times these were crystal cased with color, and other times opal cased with color, and in still other instances crystal and opal cased with a color.

[1] Contribution No. 317 from the Department of Chemistry, University of Pittsburgh.

F 15-I. Light Blue for Casing:

Sand	450 lb.
Minium	300 lb.
Potasse	120 lb.
Nitrate of potash	15 lb.
Black oxide of copper	7 lb.
Cobalt	2 oz. 120 gr.

This glass should possess a color tone intermediate between copper and cobalt blues.

F 28-II. Casing Light Blue to Case Over Enamel or Flint and Enamel for Turquoise:

Sand	150 lb.
Red lead	100 lb.
Potash	40 lb.
Nitrate of potash	5 lb.
Black oxide of copper	2 lb. 8 oz.
Cobalt	360 gr.

The basic batch is identical with F 15-I, but there is more copper oxide in proportion to cobalt oxide and, therefore, the color tone should be more nearly approximate that of a copper blue. Where enamel was included it is likely that F 25-II, given in the second installment on Sandwich glass, was employed.

Copper Alabasters

F 36-I. Iris:

Sand	240 lb.
Potasse	100 lb.
Pure precip. carb. baryta	4 lb.
Plaster of Paris	6 lb.
Fluorspar	14 lb.
Arsenic	2 lb.
Oxide of zinc	6 oz.
Black oxide of copper	1 lb. 6 oz.

As mentioned in earlier articles, the alabaster effect is due to the plaster of Paris.

F 17-II. Alabaster Iris:

Sand	180 lb.
Potash	75 lb.
Pure barium carb. precip.	3 lb.
Plaster of Paris	5 lb.
Fluorspar	10 lb.
Black oxide of copper	1 lb.
Oxide of zinc	4 oz.

F 34-I. Alabaster Blue:

Sand	240 lb.
Potasse	100 lb.
Baryta pure precip. carb	4 lb.
Plaster of Paris	6 lb.
Fluorspar	14 lb.
Arsenic	2 lb.
Sulphate of copper	7 lb.

"This is rather deep in color. If you want it lighter or darker all you have to do is to diminish or increase the copper; sulphate of copper gives a more delicate color than black oxide."

F 14-II. Alabaster Blue:

Sand	180 lb.
Potash	75 lb.
Baryta carbonate pure precip.	3 lb.
Plaster of Paris	5 lb.
Fluorspar	10 lb.
Black oxide of Copper	1 lb. 8 oz.
Arsenic	1 lb. 8 oz.

F 15-II. Another Blue:

Sand	180 lb.
Potash	75 lb.
Baryta pure carb. precip.	3 lb.
Plaster of Paris	5 lb.
Fluorspar	10 lb.
Sulphate of copper	4 lb.

F 6-I. Common Turquoise:

Sand	500 lb.
Red Lead	150 lb.
Bicarbonate of soda	180 lb.
Fluorspar	80 lb.
Felspar	80 lb.
Sulfate of copper	28 lb.
Cobalt	325 gr.

F 7-II. French Turquoise, New System:

Sand	250 lb.
Red lead	50 lb.
Potash	100 lb.
Felspar	35 lb.
Fluorspar	35 lb.
Sulphate of copper	16 lb.
Cobalt	325 gr.

Copper Opals

F 8-II. Opal Iris French:

Sand	250 lb.
Red lead	50 lb.
Potash	100 lb.
Felspar	35 lb.
Fluorspar	35 lb.
Sulphate of copper	14 lb.
Oxide of zinc	8 oz.
Cobalt	250 gr.

The color tone should be near that of a true copper blue. The large amount of copper sulfate employed would indicate that an alabaster rather than an opal glass should result.

F 9-II. Opal Celeste:

Same as above, without the oxide of zinc.	
Cobalt	380 gr.

The color tone of this glass will be slightly more towards the cobalt blue. Again an alabaster glass should result, rather than an opal.

F 56-I. Turquoise:

Sand	56 lb.
Salt petre	14 lb.
Ash	14 lb.
Lead	42 lb.
Black oxide of copper	14 lb.
Cobalt	½ oz.
Bones	6 lb.
Arsenic	1½ lb.

F 6-II. Opal Turquoise, Old English:

Sand	124 lb.
Red lead	84 lb.
Potash	28 lb.
Salt petre, nitrate of Potash	28 lb.
Bone dust	10 lb.
Arsenic	3 lb.
Brass dust	1 lb. 12 oz.
Cobalt	20 gr.

The last two batches are called "turquoise" and are the first of the opal blues, listed thus far, to contain bone ash or calcium phosphate. F 6-II gets its copper from brass dust which was mentioned in an earlier article where brass was employed.

Cobalt Blues

IN FESSENDEN'S notes he remarks, "Cobalt gives an intense blue which excessive heat does not remove, but on the contrary I think develops. There is a pink cobalt which I have obtained in Bohemia. I believe that it is a silicate of cobalt which I found better than the black oxide in producing the blue of the sapphire in imitating gems. It gives a more positive blue and a more delicate tint." The silicate of cobalt

to which Fessenden refers is also known as zaffer and smalt. Zaffer is prepared by adding a cobalt compound to an alkali silicate. When made by roasting, this preparation is blue; in fact, there is a natural blue glass which approximates it in composition. If, on the other hand, zaffer is prepared by adding a solution of an alkali silicate to one of a cobalt salt, a purple precipitate is obtained which turns to a pink on moderate heating. Whether Fessenden used the pink or the blue zaffer is not indicated. Another cobalt preparation is on the market under the name of powder blue, a potassium silicate containing from two to seven per cent of cobalt oxide equivalent varying according to the source of manufacture. Cobalt produces the rich, deep, royal blues in glass ranging from a true blue to a purple, depending on the composition of the glass.

K 27A. Blue for Syrup Bottles, Kern:

Batch	600 lb.
Cullet	300 lb.
Zaffre	2 lb.
Cobalt	12 oz.

As has frequently been observed, the crystal batch is not indicated. Cobalt probably refers to the black oxide.

F 49-II. Ordinary Blue:

Flint without lead (or demi-crystal) No. 68	100 lb.
Zaffre	2 lb.
Manganese	10 gr.

Demi-crystal F 68-II was included under crystal batches in the first installment on Sandwich glass.

F 50-II. Another Blue:

Demi crystal No. 68 or Common flint	100 lb.
Cobalt	1 oz.
Manganese	10 oz.

Manganese is added to the blue batches occasionally to increase the purplish tone.

Cobalt Blues for Casing

F 10-I. Dark Blue for Casing:

Sand	150 lb.
Minium	100 lb.
Pearlashes	40 lb.
Salt peter	5 lb.
Cobalt	3 lb.
Manganese	3 lb.

F 23-II. Casing Blue, Dark:

Sand	60 lb.
Red lead	40 lb.
Potash	16 lb.
Nitrate of potash	2 lb.
Cobalt	1 lb.
Arsenic	14 oz.

F 24-II. Another Tint:

Sand	60 lb.
Red lead	40 lb.
Potash	16 lb.
Nitrate of potash	2 lb.
Cobalt	8 oz.
Black oxide of copper	8 oz.

A small amount of copper oxide has been added here to insure a truer blue. The flint batch for use with the last three colors is probably F 22-II, which appeared in the first installment.

Cobalt Alabaster

F 11-I. Dove:

Sand	960 lb.
Potasse	400 lb.
Fluorspar	56 lb.
Plaster of Paris	24 lb.
Baryta	16 lb.
Arsenic	8 lb.
Cobalt	500 gr.

This must be a very delicate shade of blue, verging on the gray.

F 72-II. Lapis Lazuli:

Blue cullet dark made with lead	10 lb.
Melt and when melted add bone dust	10 oz.
Plaster of Paris	4 oz.

"Let this melt for about half an hour and then run off in cakes."

Evidently an attempt is made here to imitate the mineral lapis lazuli.

Manganese Colors

THE only comment about manganese in Fessenden's notes, except the method for testing which was quoted in the first installment on sandwich glass, is "Manganese gives a purple tint easily removable by heat."

F 8-I. Pink Opal:

Opal batch and cullet	2000 lb.
Manganese	6 lb.

"Manganese" as previously indicated refers to the dioxide. The opal batch is not specified.

F 18-I. Lavender Enamel:

White Enamel No. 13	14 oz.
Black oxide of nickel	4 gr.

The white enamel, F 13-I, was included in the second installment on Sandwich glass. Black oxide of nickel produces a brownish purple.

F 40-I. Amethysts or Purple:

Flint, say	300 lb.
Manganese	6 lb.

"If you want a light or dark purple all you have to do is to vary the quantity of manganese."

In this case the flint batch is not indicated.

F 56-II. Amethyst Best:

Flint No. 65	100 lb.
Manganese	3 lb.
Arsenic	4 oz.

Flint batch number F 65-II was listed in the first installment. It may be the one to which reference is made in the preceding batch.

F 57-II. Amethyst Common:

Demi crystal No. 68	100 lb.
Manganese	2 lb. 8 oz.
Cobalt	46 gr.

Here the crystal batch is number F 68-II (first installment). The crystal previously mentioned was a rich lead glass, while this one is a lime glass and much cheaper. A small amount of cobalt has been added to give the amethyst a bluish tone.

F 37-II. Casing Amethyst:

Sand	30 lb.
Red lead	20 lb.
Refined ashes	8 lb.
Nitrate of potash	1 lb.
Manganese	1 lb. 8 oz.
Green oxide of nickel	1 lb. 300 gr.

Chrome Green Aventurina.

The oxides of manganese and nickel in this small batch should have produced a very deep shade which would yield a pleasant effect in cased ware.

MANGANESE OPAL AND ALABASTER

F 11-II. Opal Lilac:

Sand	250 lb.
Red lead	50 lb.
Potash	100 lb.
Feldspar	35 lb.
Fluorspar	35 lb.
Oxide of zinc	8 oz.
Manganese	6 lb. 10 oz.
Cobalt	80 gr.

F 19-II. Alabaster Imperatrix:

Sand	180 lb.
Potash	75 lb.
Baryta, pure precip. carb.	3 lb.
Plaster of Paris	5 lb.
Fluorspar	10 lb.
Manganese	1 lb.
Cobalt	240 gr.

Evidently this is an amethyst glass with a bluish tone.

F 20-II. Alabaster Gorge de Pigion:

Sand	180 lb.
Potash	75 lb.
Baryta, pure precip. carb.	3 lb.
Plaster of Paris	5 lb.
Fluorspar	10 lb.
Manganese	2 lb.
Green oxide of nickel	100 gr.

This glass was probably the purplish gray of feathers on a pigeon's throat.

GRAY AND BLACK

F 2-I. Pearl Gray:

Sand	500 lb.
Red lead	180 lb.
Bicarbonate of soda	115 lb.
Nitrate of soda	30 lb.
Fluorspar	80 lb.
Felspar	80 lb.
Manganese	4 lb. 8 oz.
Cobalt	300 gr.

The proper balancing of cobalt and manganese oxides and at times the addition of oxides of nickel or uranium will produce a variety of grays.

F 39-I:

You can make a very nice alabaster grey by adding to	
White alabaster batch	350 lb.
Green oxide of nickel	100 gr.
Black oxide of nickel	100 gr.

The alabaster batch was probably F 5-I given in installment number two. It seems strange that two types of nickel oxide should have been employed.

F 10-II. Opal Pearl Gray:

Sand	250 lb.
Red lead	50 lb.
Potash	100 lb.
Feldspar	35 lb.
Fluorspar	35 lb.
Oxide of zinc	8 oz.
Manganese	4 lb.
Cobalt	140 gr.

K 22-A. Black:

Batch	700 lb.
Manganese	150 lb.
Oxide of Iron	50 lb.
Cullet	1400 lb.

Neither the crystal batch nor type of cullet is indicated. There is a variety of shades of black depending on the coloring agent employed. The blacks may be very dark purples or blues or browns, so dark that the eye can not detect the color.

F 9-I. Black, Best Quality:

Flint blacks	1600 lb.
Common batch	400 lb.
Manganese	200 lb.

The batch and cullet probably contained nickel oxide, as has been mentioned a number of times. The cullet is called "flint blacks" because of its dark color.

F 54-II. Best Black:

Demi crystal No. 68	100 lb.
Manganese	15 lb.
Iron scales	3 lb.
Zaffre	3 lb.

F 55-II. Another Cheaper Black:

Demi crystal No. 68	100 lb.
Manganese	15 lb.
Iron scales	1 lb.
Oxide of iron (colcoth)	7 lb.
Arsenic	1 lb.

"Colcothar" was discussed in the fourth installment under green glasses.

SILVERING

"760 grains nitrate silver dissolved in 33 oz. distilled water, graduate measure.

"760 grains caustic potash dissolved in 33 oz. distilled water, graduate measure.

"70 ccs. ammonia to 33 oz. distilled water.

"19 Dwt., 18 Grs. sugar to 9 oz. water, graduate measure, put in retort over flame until warm. Add 3 grammes nitric acid. Heat to near boiling. After cooling, add 9 oz. cold distilled water.

"For silvering use even quantities of each in the following order:

Nitrate silver
Caustic potash
Sugar and nitric acid

For small articles 15 grammes each."

This is a silvering process which is still employed in a number of glass plants. It is likely that Fessenden intended the ammonia solution to be added with the caus-

tic potash, for ammonia dissolves the precipitated silver hydroxide to form the complex $Ag(NH_3)_4$, which is present in such redissolved silver compounds. The nitric acid, which is added to the sugar, converts it to a reducing sugar. This produces a silver film from the mixture of substances indicated in the first three paragraphs in Fessenden's record. While no mention is made of warming the article which had to be silvered, it is probable that heat was applied as was customary in the older procedure.

At the time when oil lamps were in use, crystal balls were blown. These were collapsed with the pipe end at the center of the rear, so that a concave, hollow object resulted. The silvering solutions were introduced. The double-walled crystal container was held in a paddle, and a piece of rubber tubing was slipped over the neck of the container. The article to be silvered was introduced into boiling water or a water bath through which steam passed. It was necessary to leave the container open, for otherwise the ammonia pressure would have been such as to cause it to burst. After shaking back and forth a number of times a good silver film was produced on the inner walls of the reflector. The reflectors were then rinsed and placed on drying racks with the open neck down to permit drainage. A tuft of cotton was introduced into the neck. This was dipped into molten tar and a tin cap was affixed to it with plaster of Paris. The cap had a small flange which would hold the reflector in place behind the oil lamp.

Many processes are available for the silvering of glass, both hot and cold. A discussion of these will be found in the articles by the author and his collaborators[2, 3].

Summary and Conclusions

THE records of William E. Kern and George L. Fessenden furnish evidence of the ability and versatility of the Sandwich glass makers. The records which have been published have covered the fields of crystal glass; opal and alabaster; pinks and reds; ambers, yellows, and greens; blues, amethysts, grays, and blacks; and finally, the process for silvering glass. It is unfortunate that etching processes were not included in these notes, and some references to the principles employed in grinding, cutting, and polishing. Of course, there were manufacturing records beside those of William E. Kern and George L. Fessenden, which have not been available, and in which such information may be included.

While on Cape Cod in the fall of 1923 the author had the privilege of going with the late Frank W. Chipman, son of one of the Sandwich workers, to the site of the old factory. We dug into the cullet pile which was buried and unearthed specimens of many of the glasses to which reference has been made in this series of articles. There were a number of specimens which contained three layers, usually an upper layer of crystal, then particles of various colors and opal which were dropped on to the crystal gather and melted in, and finally the third layer of color, hunters' green, copper blue, or cobalt blue. Aventurina was included among the bits of color in the intermediate layer. The author has a chrome green aventurina jug with a handle which he purchased on Cape Cod and which he believes came from Sandwich. No mention is made in either Kern's or Fessenden's records of the manufacture of aventurine glass. Had the effect been limited to the small bits of this material in the triple-cased glasses, it would seem that the aventurina might have been purchased in Venice, crushed, and applied with the other colors, but when an entire vessel of chrome green aventurina is said to have come from the Sandwich plant it is probable that this type of glass was manufactured there.

A vase which was purchased on Cape Cod and claimed to be authentic Sandwich has a cobalt blue layer on the interior and a copper blue on the exterior, with flakes of biotite or mica in between. The effect is beautiful. Glasses of this type in various colors were produced in Europe at the time when the Sandwich plant was in operation, and it is likely that the Sandwich workers knew the art.

The series of articles on Sandwich glass is a tribute to William E. Kern and George L. Fessenden, although many of the batches recorded may have been the result of experimentation by their associates and by specialists who were brought into the plant from time to time. Since the completion of this series of articles, a statement came inadvertently to the author to the effect that Deming Jarves obtained some of his batches from the grandfather of one of our American glass manufacturers whose family have been glass makers for generations. There is a striking similarity between some of the Sandwich batches and those contained in the batch book of the gentleman in question. In any event, the variety of glasses produced in Sandwich equals that of any of our modern factories.

[2] A. Silverman and P. E. Neckerman, "The Silvering of Glass," Trans. Am. Ceram. Soc. 17, 505 (1915).
[3] Silverman and R. M. Howe, "Deposition of Silver Films on Glass," J. Ind. Eng. Chem. 9, 1032 (1917).

LABORATORY GLASSWARE STANDARDS REVISED

The National Bureau of Standards of the Department of Commerce have advised manufacturers, distributors and users of laboratory glassware of a change in standards effective for new production from May 15, 1936. This new standard, which will be identified as CS21-36, applies to interchangeable ground-glass joints, stopcocks and stoppers. The recommendations for revision were circulated under date of March 18 and in view of the absence of active opposition have been adopted. Printed copies of the revision may be obtained from the National Bureau of Standards, Washington, D. C.

GLASS BUILDINGS FOR DALLAS EXPOSITION

Water-clear glass bricks that are translucent but not transparent, and which will admit a vast amount of daylight, will be used for the construction of buildings at the Texas Centennial Exposition at Dallas. This new glass masonry will also be used in the construction of huge pylons in front of the Exposition's administration building, in the fountains at the end of the largest reflecting basins and in a tall shaft in the live stock area.

Owens-Illinois Glass Co., developers of this new material, will have an exhibit in the Varied Industries Building, which will also be constructed largely of glass block. Among their exhibits will be glass fibre displayed in its many new applications for insulation and air filters, as well as its possibilities as a textile.

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	...	.29
Hydrochloric (HCl) 20° tanks	Per 100 lb.	...	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	...	.13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 130 lb. carboy ext.	Per 100 lb.	...	5.50
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	...
Tartaric	lb.	...	Po. or Gr. .25 / Cry. .25½
Aluminum hydrate (Al $(OH)_3$)	lb.	.04-.04½	.04½-.05
Aluminum oxide (Al_2O_3)	lb.	.04	.05
Ammonium bicarbonate (f.o.b. works)	lb.	.0515	...
(f.o.b. N. Y.)	lb.	...	.0571
Ammonium bifluoride (NH_4)FHF	lb.	...	.14½
Ammonium nitrate (NH_4NO_3)	lb.	...	.08
Ammonia water (NH_4OH) 26° drums	lb.	...	.02¾
Antimonate of Sodium	lb.	.12¾	.13¾
Antimony oxide (Sb_2O_3)	lb.	...	.13¾
Antimony sulphide (Sb_2S_3)	lb.	...	.13
Arsenic trioxide (As_2O_3) (dense white) 99%	lb.	.03½	.04-.04½
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	40.00	45.00
90% through 100 mesh	ton	38.00	...
Barium hydrate (Ba $(OH)_2$)	lb.	.0475	.05½
Barium nitrate (Ba $(NO_3)_2$)	lb.	...	.07¾
Barium selenite ($BaSeO_3$)	lb.	...	1.50-1.75
(Commercial, 25% Selenium)	lb.	...	.90
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00-16.00	18.00
Bone ash	lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	...	...
Granulated	In bags, lb.	.022	.0245-.027
Powdered	In bags, lb.	.0245	.027-.0295
Boric acid (H_3BO_3) granulated	In bags, lb.	.05	.0525-.055
Cadmium sulphide (CdS)—	lb.	...	1.00-1.10
Calcium phosphate ($Ca_3(PO_4)_2$)	lb.	.07	.07½
Chromite	lb.	...	.0215
Cerium hydrate 100 lb. drums and 600 lb. barrels	lb.	...	.65
Chrome Oxide Green, 400 lb. bbls.	lb.	.17	.215-.25
Cobalt oxide (Co_3O_4) In bbls.	lb	...	1.41
In 10 lb. tins	lb.	...	1.51
Copper oxide Red (Cu_2O)	lb.	...	.20
Black (CuO)	lb.	...	.15
Black prepared	lb.	...	.22
Cryolite ($Na_3Al\ F_6$) Natural Greenland (Kryolith)	lb.	.08½	.09
Synthetic (Artificial)	lb.	.08½	.09
Epsom salts ($MgSO_4$) (imported) technical	Per 100 lb.	...	2.30
Feldspar— 20 mesh	ton	11.00-13.25	
40 mesh	ton	11.50-13.75	
Granular	ton	11.75-14.00	
Semi-granular	ton	11.00-13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags			
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2 2½%) Bulk, carloads, f. o. b. mines	ton	31.50	...
In bags	ton	33.10	38.00-40.60
Formaldehyde, bbls.	lb.	...	.07
Graphite (C)	lb.	...	.04-.07
Iron oxide— Red (Fe_2O_3)	lb.	...	.0425
Black ($Fe3O_4$)	lb.	.04½	...
Iron chromate	lb.	...	.035-.05
Kaolin (f. o. b. mine)	ton	8.00-9.00	...
English, lump, f. o. b. New York	ton	14.50-25.00	24.50-30.00
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	...	.16
Lead oxide (Pb_3O_4) (red lead) (N. Y.)	lb.	.0710	...
In 5 Ton lots	lb.	...	.075
Less than 5 Tons	lb.	...	.08

		Carlots	Less Carlots
Lime— Hydrated (Ca $(OH)_2$) (in paper sacks)	ton	10.50	...
Burnt (CaO) ground, in bulk	ton	7.00	...
Burnt, ground, in paper sacks	ton	9.00	...
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.25	2.25
Limestone ($CaCO_3$)	ton	1.75	...
Litharge (PbO) (New York Prices)	lb.	.0610	...
In 5 Ton lots	lb.		.065
Less than 5 Tons	lb.		.07
Magnesium carbonate ($MgCO_3$)	lb.	.0610	.08-.09
Magnesium sulphate (U.S.P.)	lb.	...	.0265
Manganese, Black Oxide In Paper bags	ton	47.50	52.50-55.00
In Burlap bags	ton	51.50	54.00-56.50
In Casks	ton	53.00	55.50-58.00
Neodymidm oxalate, 50 lb. drums	lb.	...	5.00
Nickel oxide (Ni_2O_3), black	lb.	...	.35-.40
Nickel monoxide (NiO), green	lb.	...	.35-.40
Plaster of Paris, bags	ton	31.00	23.00 29.00
Potassium bichromate ($K_2Cr_2O_7$)— Crystals	lb.	...	.09
Powdered	lb.	...	.09½
Potassium carbonate Calcined (K_2CO_3) 96-98%	lb.	.06¾	.07¼
Hydrated 80-85%	lb.	.06	.06¼-.06¾
Potassium Chromate (K_2CrO_4) 100 lb. kegs	lb.	...	.27
Potassium hydrate (KOH) (caustic potash)	lb.	.06¾-.06½	.08-.08½
Potassium nitrate (KNO_3) (gran.)	lb.	.0545	.06-.06¼
Potassium permanganate ($KMnO_4$)	lb.	...	.19
Powder blue	lb.	...	.18¾-.19¼
Rare earth hydrate 100 lb. drums	lb.	...	.35
325 lb. barrels	lb.	...	.30
Rochelle salts, bbls.	lb.	...	.12½
Rouge	lb.	...	Po. or Gr. .13½ / Cry.
Rutile (TiO_2) powdered, 95%	lb.	.10-.12	.13-.15
Salt cake, glassmakers (Na_2SO_4)	ton	18.00	27.00
Selenium (Se) In 100 lb. lots	lb.	...	2.00
In lesser quantities	lb.	...	2.10
Silver nitrate ($AgNO_3$) . (100 oz. bot.) per oz.		...	.39
Soda ash (Na_2CO_3) dense, 58%— Bulk	Flat Per 100 lb.	1.10	...
In barrels	Per 100 lb.	1.50	...
In bags	Per 100 lbs.	1.25	...
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06½	.07
Sodium chromate ($Na_2CrO_4 10H_2O$)	lb.	...	.08¼
Sodium fluosilicate (Na_2SiF_6)	lb.	.06½	.07
Sodium hydrate (NaOH) (caustic soda) Flake	Per 100 lb.	3.00	...
Solid	Per 100 lb.	2.60	...
Sodium nitrate ($NaNO_3$)— Refined (gran.) in bbls.	Per 100 lb.	...	2.00-2.25
95% and 97% Bulk	Per 100 lb.	1.225	...
200 lb bags		1.29	1.34
100 lb. bags		1.325	1.375
Sodium selenite (Na_2SeO_3)	lb.	..	1.80-2.00
Sodium uranate (Na_2UO_4) Orange	lb.	...	1.50 1.55
Yellow	lb.	...	1.50-1.55
Sodium uranyl carbonate	lb.	...	.80-.90
Sulphur (S)— Flowers, in bbls.	Per 100 lb.	3.35	3.70-4.10
Flowers, in bags	Per 100 lb.	3.00	3.35-3.75
Flour, heavy, in 250 lb. bbls.	Per 100 lb.	2.90	3.25-3.65
Tin chloride ($SnCl_2$) (crystals) in bbls.	lb.	...	.35½
Tin oxide (SnO_2) in bbls.	lb.	...	.51
Uranium oxide (UO_3) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	...	2.25
Yellow orange	lb.	...	1.50
Zinc oxide (ZnO) American process, Bags	lb.	.05	.05¼
White Seal, 150 lb. bbls.	lb.	.06¾	.07
Green Seal bags	lb.	.06½	.06¾
Domestic White Seal bags	lb.	.06	.06¼
Red Seal, bags	lb.	.05½	.05¾
Zircon Granular (Milled .005-.02c higher)		.07	.67½-.08
Crude. Gran. (Milled .005-.02c higher)		.03½	.04-.05

EQUIPMENT AND SUPPLIES

PHILADELPHIA GEAR ADDS TWO NEW REDUCERS

Two new sizes (No. 405 and No. 444) have been added by the Philadelphia Gear Works to their standard series of totally enclosed, fan-cooled motor reducers in both the vertical and horizontal types. Both new sizes are waterproof and dust-proof. Unit No. 444 is said to have a very efficient double ventilation system provided by hollow inner fins through which the air is circulated by a fan.

With several refinements, the new units follow the modern "streamline" design adopted two years ago. The principal advantages of this type of design are said to be: a better alignment of pinions and gears which reduces noise and wear, conservation of space and rugged assembly that, because it has no overhung parts, will not shake itself to pieces.

Additional data on such topics as lubrication, thrust ratings, overhung capacities, dimensions and detail drawings are given in Bulletin MR36, Philadelphia Gear Works, "G" Street and Erie Avenue, Philadelphia.

The Chain Belt Co., Milwaukee, has moved its Pittsburgh office to Room 526 Grant Building, Pittsburgh, Pa. G. E. Mahoney, formerly a sales engineer in the Milwaukee office will be located in Pittsburgh. He is well known to glass manufacturers, having specialized in engineering relative to glass batch handling.

General Refractories Co., Philadelphia, has appointed E. Corey & Co., Portland, Me., as their dealer agents in that territory for a complete stock of refractories.

CATALOGS RECEIVED

Index to Bristol's Industrial Instruments. Bulletin 435. The Bristol Co., Waterbury, Conn. An excellent index of Bristol's instruments for recording, indicating and controlling to be placed inside a binder of the Company's catalogs. Affords a check-list of the company's literature.

Ohio Gear Co., 1333 East 179 St., Cleveland, Ohio. A 128-page catalog describes the line of spur, bevel, worm and other gears, as well as motorized speed reducers. Also furnishes technical data, including S. A. E. heat-treatment methods.

Redler Conveyors and Elevators. Stephens-Adamson Manufacturing Co., Aurora, Ill. Drawings, diagrams and photographs graphically illustrate this handsome catalog for the unique Redler conveyor-elevator which is designed to handle coal, dry chemicals and similar bulk materials.

Metal-Clad Switch Gear Type MI-6. GEA-1661A. General Electric Co., Schenectady, N. Y. A brochure illustrated with several blueprints and photographs advises that this equipment will reduce installation costs, protect station operators, simplify station layouts and assure continuous service.

Multi-Wash. No. 10. Claude B. Scheibe Co., Chicago, Ill. Illustrates and describes the wet method of dust and fume collection and shows a great many installations of this equipment.

The Standard Hand Book of Refractories. No. 37. Standard Fuel Engineering Co., Detroit, Mich. A 48-page manual for engineers, plant superintendents and others interested in the control of heat. Gives information about Zero brand refractory cements, refractories, heat treating and furnaces, as well as useful tabular matter for those refractory materials requiring specific formulae.

Micromax Electric Control. Catalog N-OO. A. Leeds & Northrup Co., Philadelphia. Describes an electric control which is based on a simple potentiometer balance. The equipment consists of three parts, a Micromax control instrument, relay detector and valve mechanism.

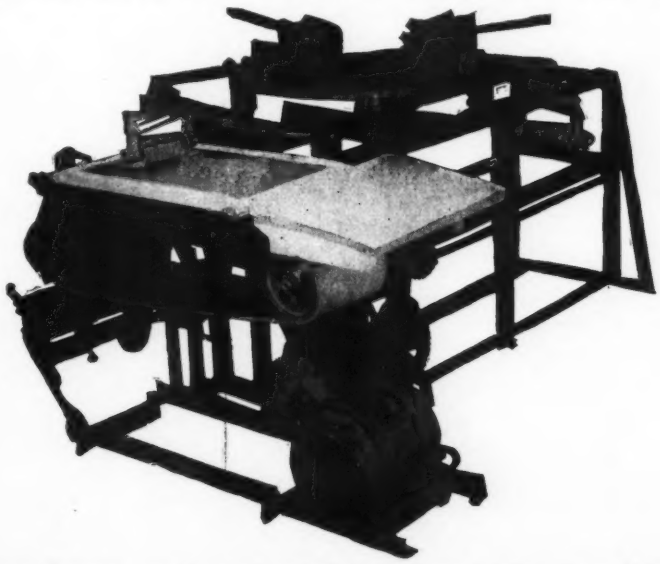
Instruments for Spectrographic Analysis. Catalog D-20. Bausch & Lomb Optical Co., Rochester, N. Y. A revision of a catalog first issued in 1936, this 31-page booklet contains much pertinent data and illustrative material. A feature is a bibliography of various scientific works on spectrographic analysis.

Industrial Compressors and Vacuum Pumps. No. 7502-E. Ingersoll-Rand Co., 11 Broadway, New York. A 28-page catalog dealing with the company's "Type 30," line of industrial compressors and vacuum pumps. Various types of units are illustrated.

NEW SQUEEGEE MACHINE DEVELOPED BY HOMMEL

The O. Hommel Co., Pittsburgh, Pa., after several years of continuous research and development has developed an automatic decorating machine, called the Squeegee Machine. Equipped with an automatic paste feeder and automatic turn table, this machine is capable of decorating between 40 and 60 tumblers, jars or similar ware a minute. The size of the containers makes no difference for with its adjustable arms and chucks the machine can decorate large and small pieces.

At present the containers are fed by hand but the O. Hommel Co. is developing an automatic feeder which will quicken the handling of ware and speed up production. Further details may be obtained by writing the company at 209 Fourth Ave., Pittsburgh.



The new Squeegee machine now marketed after several years of experimenting.

INTERNATIONAL GLASS CONGRESS

(*Concluded from page* 195)

The United Glass Bottle Manufacturers, Ltd., Charleton. Automatic machine-made bottles.

Messrs. Rockware Glass Syndicate, Ltd., Greenford, Middlesex. Automatic machine-made bottles.

General Electric Company's Glass Works and Research Laboratories, Wembley, Middlesex. Electric light bulbs, radio valves, and glass tubing, by fully automatic process.

James Powell & Sons (Whitefriars), Ltd., Wealdstone, Middlesex. Hand made, plain and cut table glass. Decorative glass of all descriptions, including stained glass and mosaics.

The American Committee for the Congress consists of: F. C. Flint, president; J. C. Hostetter, secretary; H. H. Blau, A. N. Finn, J. S. Gregorius, F. W. Preston, S. R. Scholes, Alexander Silverman, J. T. Littleton, J. M. McKinley, and Ross C. Purdy.

Membership in the Second International Congress on Glass is open to "all persons interested either in the manufacture or use of glass for any purpose whatever." The subscription is 21s.

GLASSMAN HEADS ROCHESTER AD CLUB

Milton C. Williamson, advertising manager, Bausch & Lomb Optical Co., Rochester, N. Y., has been elected 28th president of the Rochester Advertising Club. The Rochester club, one of the oldest and most active in the country, has a membership of over 600. Mr. Williamson, who has been associated with Bausch & Lomb for eleven years, will serve during the 1936-37 term.

ALL-GLASS BUILDING FOR MIAMI

Pittsburgh Plate Glass Co. will erect an all-glass building on Biscayne Boulevard near the Causeway in Miami, Fla. It will serve as a practical example of the versatility of modern glass, as well as house a warehouse, branch office and built-in model house which will incorporate the latest ideas in the use of glass and paint.

The exterior of the building will utilize the two distinct types of structural glass which have recently introduced a new note in building design. They are Carrara glass which is entirely opaque with a highly polished colored plate glass surface and glass brick which is partially opaque, transmitting a maximum of light but a minimum of heat.

Although complete details have not yet been announced, it is expected that the many different types of glass which have been developed during the past decade for practical application to modern living conditions and current architectural and decorative trends will be utilized.

A new Aircraft Bubble Sextant, with which the altitude of heavenly bodies may be measured without depending on a sea horizon has been designed in the laboratories of Bausch & Lomb from plans submitted by the Bureau of Aeronautics and Lt. Commander P. V. H. Weems. The new instrument is intended primarily for use with aircraft, but is equally useful to surface vessels during the period between evening and morning when stars are visible but no horizon, or on occasions when the sun can be momentarily seen through rifts in fog but no horizon is visible from which to measure the angle.

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